SUPERFUND FIVE YEAR REVIEW REPORT

for

ELMORE WASTE DISPOSAL SUPERFUND SITE

Prepared by

U.S. Environmental Protection Agency, Region 4
Atlanta, Georgia

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LIST OF ACRONYMS

COC - Contaminant of Concern

CPW - Commission on Public Works, City of Greer, South Carolina

DNAPL - Dense Non-Aqueous-Phase Liquids

EPA - United States Environmental Protection Agency, Region 4

ESD - Explanation of Significant Differences

IC - Institutional Control(s)

O&M - Operations and Maintenance

POTW - Publicly-owned treatment works. In this document, "POTW" refers to the City of Greer Commission on Public Works (CPW).

PTS - Pump-and-Treat System

RA - Remedial Action

RD - Remedial Design

RI/FS - Remedial Investigation/Feasibility Study

RPM - Remedial Project Manager

ROD - Record of Decision

RPM - Remedial Project Manager

SCDHEC - South Carolina Department of Health and Environmental Control

VOC - Volatile Organic Compounds

EXECUTIVE SUMMARY

During June through August 2003, the U.S. Environmental Protection Agency, Region 4 (EPA), conducted a Five Year Review of the Superfund remedy implemented at the Elmore Waste Disposal Site ("the Site") located in Greer, Spartanburg County, South Carolina. This report documents the results of that review.

The Site consists of an approximately 8-acre area that includes a 1-acre residential backyard (the original Elmore property) which is bounded on the north by a railroad line and, farther to the north, a larger neighborhood area of about 20 residences.

A 10-well groundwater pump-and-treat system (PTS) was constructed during 1997-1998 and has been in operation since September 1998. The 1993 Site Record of Decision (ROD) also called for excavation and offsite disposal of a small area of contaminated soil located on the former Elmore property. This soil remedial action was completed in 1995. The groundwater PTS is the only remaining and active component of the Site remedy.

Review of the Site remedy as implemented since the 1993 ROD indicates, in summary, that the Site PTS is operating as originally designed in the RD (1996-98), but needs improvement in its effectiveness and efficiency in order to perform as intended by the ROD and the RD. *Operational* issues identified by the 2001 Remedial Systems Evaluation (RSE) Report and subsequent optimization work should be pursued, but do not bear on long- or short-term protectiveness. These problems can most likely be resolved through continued improvements. However, significant remedy *performance* issues were identified, which probably impact long-term protectiveness. Current data indicate that some escape of contaminated groundwater offsite to the northeast is occurring, and that some contaminated groundwater escapes the PTS and appears in creek-bed groundwater entering Wards Creek, bordering the Site to the north. These findings indicate that the horizontal and vertical extent of contamination must be further investigated in order make the necessary changes to PTS configuration and capabilities, which in turn will allow adequate capture to be achieved. Although there is no known groundwater use nearby, ensuring long-term protectiveness will require that these actions be completed.

The remedy at the Elmore Waste Disposal Site currently protects human health and the environment because the PTS is capturing a significant portion of the contaminated groundwater moving offsite; current data indicate contamination is entering the creek at the Site boundary and not escaping under it; there is no current exposure; and adequate notice to the public is being maintained to prevent exposure. However, the actions described generally above, and listed in Section 8 of this Five-Year Review Report, must be completed in order for the remedy to be protective in the long-term.

FIVE YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: **Elmore Waste Disposal**		
EPA ID: **SCD 980 839 542**		
Region: 4	State: **South Carolina**	City/County: **Greer, Spartanburg County**
SITE STATUS		
NPL status: **Final**		
Remediation status: **Operating**		
Multiple OUs? **No**	Construction completion date: **09/24/1998**	
Has site been put into reuse? **No**		
REVIEW STATUS		
Lead agency: **EPA**		
Author: **Ralph O. Howard, Jr.**	Author affiliation: **U.S. EPA Region 4**	
Author title: **Remedial Project Manager**		
Review period: **06/01/2003 - 09/19/2003**		
Date of site inspection: **06/11/2003**		
Type of review: **(Post-SARA) Policy**		
Review number or successive: **First Five Year Review**		
Triggering action / date: **Five years from Construction Complete/PCOR: 09/24/1998**		
Due Date: **09/24/2003**		

Issues:

1. The contaminated groundwater plume needs to be defined along the eastern boundary in both the shallow and intermediate aquifers, to support modifying the PTS and achieving capture or treatment.
2. The PTS' vertical depth of capture needs to be verified through well measurements and/or sample evidence from groundwater entering Wards Creek. Additional verification that no escape is occurring under the creek should be obtained.

3. Capture along the North Line and South Line needs to be improved in order to achieve full capture and prevent contaminant escape into Wards Creek. 4. On the former Elmore property, the area surrounding sample location A6 may be highly contaminated enough to affect how the PTS is to be modified. 5. Crawl-space air sampling results (May 2003) are in review and could require that remedial actions be taken to mitigate risks.
Recommendations and Follow-up Actions: Follow-up actions and milestones are listed in Section 8 of this report.
Protectiveness Statement: The remedy at the Elmore Waste Disposal Site currently protects human health and the environment because the PTS is capturing a significant portion of the contaminated groundwater moving offsite; current data indicate contamination is entering the creek at the Site boundary and not escaping under it; there is no current exposure; and adequate notice to the public is being maintained to prevent exposure. However, in order for the remedy to be protective in the long-term, the actions listed in Section 8 of this Five Year Review Report need to be taken. The actions include: (1) conducting an additional phase of characterization work to address issues of plume delineation and escape, work which may be iterative with any PTS modifications undertaken; (2) implementing physical modifications to the PTS to improve capture; (3) investigating the area surrounding sample location A6 on the former Elmore property, and taking appropriate response actions; and (4) reporting the 2003 crawl-space air sampling results to the public, and completing any necessary remedial actions.
Other comments: Because the Site remedy will continue for more than five years, and contaminated groundwater remains at the Site, a second Five Year Review will be completed five (5) years from the date of this report, which will be September 23, 2008.

9/24/03

Winston A. Smith, Director
Waste Management Division
U.S. EPA, Region 4

Date

SECTION 1 Introduction

1.1 General

During June through August 2003, the U.S. Environmental Protection Agency, Region 4 (EPA), conducted a Five Year Review of the Superfund remedy implemented at the Elmore Waste Disposal Site ("the Site") located in Greer, Spartanburg County, South Carolina. This report documents the results of that review. This is the first Five-Year Review for the site.

1.2 Authority

EPA is preparing this report in accordance with its policy set forth in the National Oil and Hazardous Substance Contingency Plan (NCP), the regulatiuon which implements the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), known as Superfund. CERCLA requires that periodic reviews be conducted, at least every five years, at sites where hazardous substances pollutants or contaminants remain onsite above levels that would allow for unlimited use and unrestricted exposure. Section 300.430 (f) (4) (ii) of the NCP further interprets the requirement to apply to all sites for which implementation of all remedial actions will not leave hazardous substances, pollutants or contaminants onsite at such levels, but the remedial actions will require more than five years to complete. Completion of the Site remedy at this site will require more than five years. September 2003 represents the passage of five years since the remedy became operational at the Site.

1.3 Purpose

The purpose of a Five-Year Review is to determine whether the remedial action at a site remains protective of human health and the environment. The methods, findings and conclusions of reviews are documented in Five-Year Review Reports. In addition, any issues identified during the review are presented, along with recommendations to address them.

1.4 Site Remedy

A 10-well groundwater pump-and-treat system was constructed during 1997-1998 and has been in operation since September 1998. The 1993 Site Record of Decision (ROD) also called for excavation and offsite disposal of a small area of contaminated soil. This soil remedial action (RA1) was completed in 1995. The groundwater pump-and-treat system (RA2) is the only currently-active component of the Site remedy.

1.5 Five-Year Review Roles

EPA is the lead agency for this Five Year Review. The State of South Carolina, represented by the SC Department of Health and Environmental Control (SCDHEC), serves as the support agency under Superfund and has provided review and comments on this document. Since the Site is Fund-Lead, EPA is responsible for the Remedial Action (RA). EPA's RA Operations and Maintenance (O&M) Contractor, Black & Veatch Special Projects Corporation (referred to as "the RA Contractor"), operates and maintains the pump-and-treat system. Much of the figures and tables presented in this Five Year Review are taken from the RA Contractor's quarterly O&M reports.

SECTION 2 Site Chronology

The following table highlights key dates in the history of the Site.

Table 1: Site Chronology

Event	Date
State discovery and initial State actions	1977-80
EPA Discovery	06/1980
EPA Preliminary Assessment	06/1984
EPA Site Inspection complete	10/1984
State Removal Action complete	08/1986
Proposal to NPL, Final Listing on NPL	06/1988, 3/1990
ROD signature (RI/FS complete)	04/1993
Explanation of Significant Differences (ESD)	07/1994
Remedial Action (Soil, RA1) complete	01/1995
Remedial Design (Groundwater, RD2) start	07/1993
Remedial Design (Groundwater, RD2) complete	09/1995
Remedial Action Physical Construction Start	10/1997
Superfund State Contract signature (Second Amendment, Groundwater)	03/1998
Construction complete, Preliminary Close-Out Report	09/1998 (09/24/98)

Operational and Functional (O&F)	11/1999
First Five-Year Review	09/2003

SECTION 3 Background

3.1 Site Location and Description

The Elmore Waste Disposal Site, in Spartanburg County, South Carolina, is located in a residential area in the easternmost portion of the City of Greer. The Site consists of an approximately 8-acre area that includes a 1-acre residential backyard (the original Elmore property) which is bounded on the north by a railroad line (Figures 1, 2), and to the north, a larger area of about 20 residences north of the railroad line (Figure 3). To the east (beyond Sunnyside Drive) and west (beyond Mason Street) are additional residential areas and some commercial and light-industrial facilities.

3.2 Land and Resource Uses

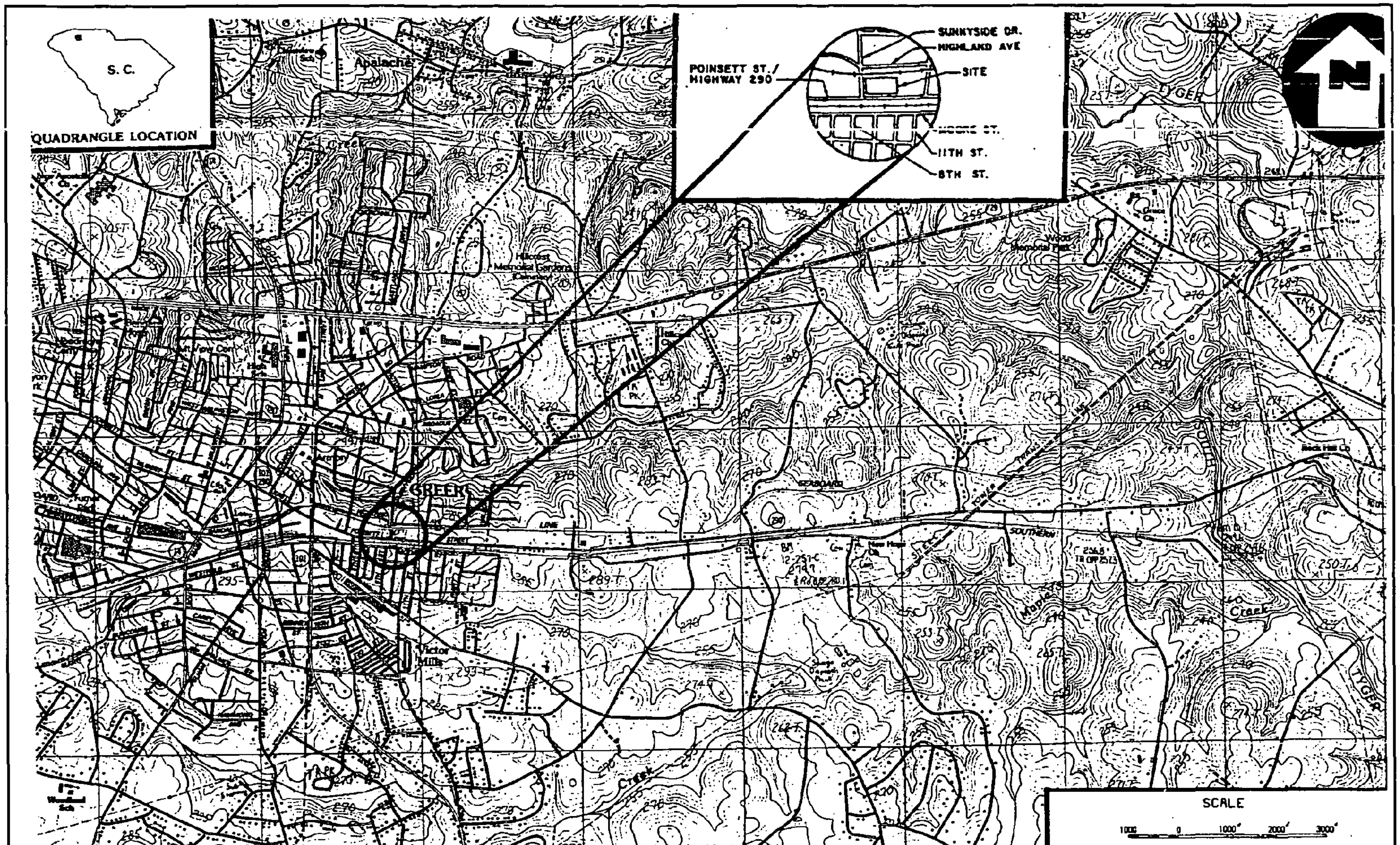
Areas surrounding the Site are within the city limits of Greer, and include mainly residential properties, with some commercial and light-industrial sites. The nearest surface water body, Wards Creek, borders the Site to the north (see Figure 3). Recent discussions between the EPA Site RPM and the City of Greer zoning and planning coordinator indicate the land usage is not expected to change.

Groundwater is not used within the Site boundaries, nor in the immediate area (1/4-mile radius). Wards Creek is very shallow and rocky, with some household trash present on the creek banks, and is not used for recreation or fishing.

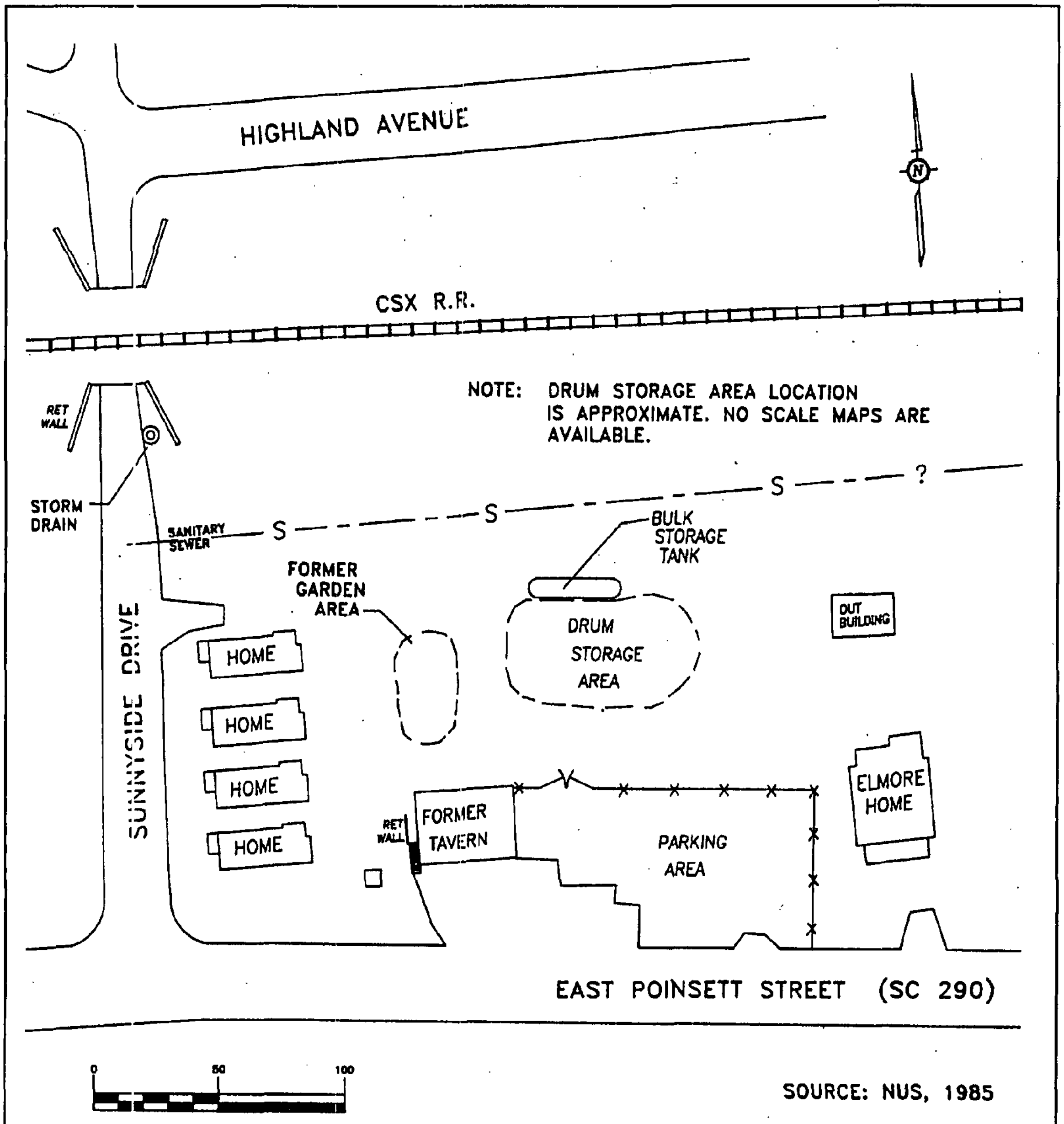
3.3 History of Contamination at the Site

Between 1975 and 1977, a large number of drums containing liquid wastes were placed on the Elmore property. In 1977, the property owner signed a Consent Order with the State of South Carolina for cleanup of the Site. In 1979, the South Carolina Department of Health and Environmental Control (SCDHEC) notified the property owner that the terms of the Consent order had not been complied with, and to stop use of the Site. Between 1981 and 1984, SCDHEC and EPA investigated Site conditions and found arsenic, chromium, and other heavy metals, as well as a number of volatile organic compounds (VOCs), in Site soils. At various times during this period there were between 150 and 300 drums present onsite, as well as a 6000-gallon partially-buried tank containing contaminated, waste oil. After the property owner died in 1983, ownership passed to his heirs, one of whom continued to operate the Site and accept waste drums.

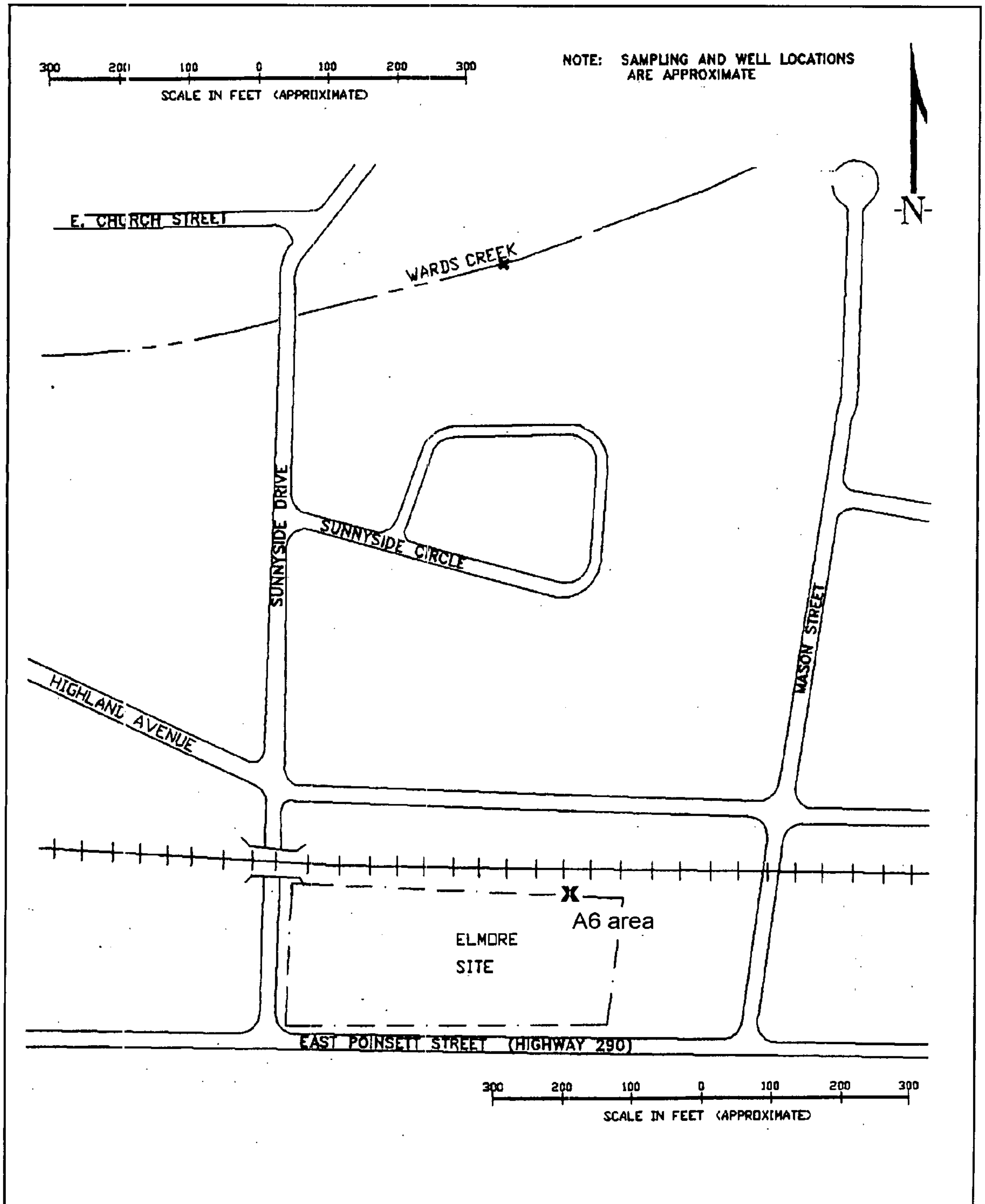
Figure 1. Site Location



Five Year Review Report **Elmore Waste Disposal Superfund Site** **September 2003**	**FIGURE 1** **Site Location** (Adapted from Feasibility Study, Black & Veatch, 1992)



Five Year Review Report **Elmore Waste Disposal Superfund Site** **September 2003**	**FIGURE 2** **Site Layout Prior to 1986** **State Removal Action** (Adapted from Feasibility Study, Black & Veatch, 1992)



Five Year Review Report **Elmore Waste Disposal Superfund Site** **September 2003**	**FIGURE 3** **Site including Northern Portion** **(Highland Avenue/Sunnyside Circle)** (Adapted from Feasibility Study, Black & Veatch, 1992)

After all efforts to compel this operator to clean up the Site failed, SCDHEC in June 1986 accomplished a state-funded removal action of 5,500 tons of contaminated soil and 16,800 pounds of liquid wastes, which were taken to an appropriate hazardous waste facility. Groundwater monitoring wells installed after this removal indicated that groundwater was contaminated by several VOCs.

In June 1988, the Elmore Waste Disposal Site was proposed for addition to the National Priorities List (NPL). The Site was added to the NPL on March 30, 1990. A Potentially Responsible Party (PRP) Search completed in November 1988 did not result in identification of any viable PRPs. Subsequent efforts to identify viable PRPs also failed, and in 1990 EPA elected to initiate a Remedial Investigation/ Feasibility Study (RI/FS) using public funds under CERCLA. All Superfund actions to date have been Federal lead.

3.4 Basis for Taking Action

EPA conducted the RI/FS during 1991-1992. The RI/FS established that a highly contaminated groundwater plume extended some 1100 feet north from the Site, consisting primarily of two common solvents, trichloroethylene (TCE) and tetrachloroethylene (PCE). Levels of total volatile organic compounds (VOCs) ranged up to 16 mg/L. The estimated area underlain by the plume was approximately 7 acres. Additionally, surface soil in a 1/4-acre area at the western end of the Site was found to be contaminated by lead and arsenic at levels exceeding health-based residential standards for those metals. The Baseline Risk Assessment determined that the risks from both potential groundwater use and from exposure to surface soils were above acceptable levels.

Groundwater contamination was limited to the shallow aquifer on the former Elmore property, but was found to be present in both the intermediate-depth and deep aquifer farther to the north (Appendix 1; see Fig. 3 in Appendix). Based on RI data, the volume of the affected portion of the aquifer was estimated in the FS as 67 million gallons. Since a 55-foot maximum depth of contamination was assumed, this estimate is known to be low in light of additional information developed later in the RD concerning the vertical extent of contamination. Although no private water wells are located near this plume, the groundwater discharges to Wards Creek, behind neighborhood homes.

The area of contaminated surface soil requiring action was estimated as 8775 square feet. For surface soil replacement a depth of 2 feet was used, so that the volume of soils requiring remediation was 650 cubic yards. Appendix 1, the Proposed Plan Fact Sheet, provides an overview of the RI/FS and includes maps of the areal extent for both soil and groundwater contamination.

After the RI/FS was completed, EPA and SCDHEC investigated the Sunnyside Circle neighborhood separately, as a separate site, based on the concerns of area residents and the discovery that the neighborhood had been built, in the mid-1960s, on the location of a former surface dump. The investigation led to an EPA removal of surface soils in most of the neighborhood, which was completed in 1995. As part of the investigation, SCDHEC installed two wells on the northernmost part of Sunnyside Circle, and one well across Wards Creek to the north. The well across the creek showed no impact, but those in Sunnyside Circle confirmed that deeper, intermediate-depth VOC contamination was present.

Groundwater investigation and sampling since the RI, in the Sunnyside neighborhood, has produced only limited evidence for any source other than the former Elmore property (occasional trace gasoline constituents, generally < 0.100 mg/L total). Otherwise, no chemicals have been detected besides those from shallow wells clearly associated with the original Elmore Site (well clusters MW-5, MW-6 and MW-7).

SECTION 4 Remedial Actions

4.1 Remedy Selection

On April 26, 1993, EPA issued a Record of Decision (ROD) for the Elmore Waste Disposal Site, which set forth EPA's selected remedy. The remedy addressed all contaminated media and was intended to constitute the final remedy for the Site.

4.1.1 Remedy Components

The ROD presented the following two major components:

A. GROUNDWATER (Pump and Treat)
   1- Extraction of contaminated groundwater;
   2- On-site treatment of extracted groundwater:
      - Air stripping for removal of VOCs from groundwater; and
      - Physical/chemical treatment to remove inorganic contaminants;
   3- Discharge of treated groundwater to a local Publicly-Owned Treatment Works (POTW);
   4- Continued analytical monitoring of Site groundwater and surface water.

B. SOIL (Source Control)

   - Excavation of contaminated surface and subsurface soil, with verification sampling;
   - Transport and disposal of the soil at an appropriate hazardous waste facility;
   - Replacing the excavated soil with clean fill material and restoration of the land surface.

4.1.2 Remedial Action Objectives and Remedial Goals

The following Site Remedial Alternative Objectives (RAOs) were developed in the FS and presented in the ROD:

1. Prevent ingestion of any groundwater containing:
   a. carcinogen concentrations above Federal or State standards, or if there is no standard, above levels that would allow a remaining excess cancer risk of greater than 1×10^{-4} to 1×10^{-6}; and
   b. noncarcinogen concentrations above Federal or State standards, or if there is no

standard, above levels that would allow an unacceptable remaining noncarcinogenic threat (HI greater than 1).

2. Restore the groundwater aquifer to potential productive use by remediation to an appropriate degree, and by preventing migration of the contaminant plume beyond the existing boundary.
3. Prevent ingestion of, or direct contact with, soil contaminated at levels that pose unacceptable carcinogenic or noncarcinogenic risk.
4. Prevent leaching of contaminants from soil to groundwater that would allow contaminant levels above appropriate standards to remain in groundwater.
5. Reduce or eliminate the contaminant concentrations in Wards Creek, and maintain water quality in accordance with Federal and South Carolina Ambient Water Quality Criteria for surface waters.

In order to accomplish the RAOs, Remedial Goals (RGs) were established for both soil and groundwater. RGs for soil were established based on contact (surface soils) and protection of groundwater (subsurface). The RGs are shown in Tables 2 and 3 below.

Table 2: Soil Remediation Goals (mg/kg)

Surface Soil(1):	Arsenic	10
	Beryllium	4
	Lead	500
Subsurface Soil(2):	Arsenic	300
	Beryllium	9
	Cadmium	4
	Chromium	800
	Manganese	10,000
	Nickel	400
	Vanadium	600
(1) RG based on dermal exposure (2) RG based on protection of groundwater		

Table 3: Groundwater Remediation Goals, mg/l

Benzene	0.005
Carbon Tetrachloride	0.006
Cis-1,2-Dichloroethene	0.070
Methylene Chloride	0.005
Tetrachloroethylene	0.005
Trichloroethylene	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.005
Vinyl Chloride	0.002
*Beryllium	0.004
*Cadmium	0.005
*Lead	0.015
*Manganese	3.0
*Chromium	0.100
*Nickel	0.100
*Vanadium	0.200

All of the volatile organic groundwater RGs (those without asterisk) are based upon the applicable MCLs, except methylene chloride (also called dichloromethane). The RG for that chemical was based on the South Carolina proposed secondary MCL for that chemical. Since the time of the ROD, a Federal MCL has been established for methylene chloride.

The RGs for the inorganic contaminants of concern (COCs) listed above (those marked with an asterisk) were deleted by the July 1994 Explanation of Significant Differences (ESD). The ESD made two changes to the groundwater remedy component. First, the requirement for on-site treatment to remove VOCs was revised to require that treatment be conducted on-site only to the degree necessary for acceptance of the combined effluent by the local publicly-owned treatment works. The discharge option for the treated water remained unchanged (discharge to local publicly-owned treatment works). Additionally, the public was advised that physical/chemical treatment of the extracted groundwater to remove inorganic COCs (metals) would not be required, because improved groundwater sampling methods had been used since the time of the ROD, and based on them, Site groundwater monitoring results were clearly indicating that metals were not present at levels above standards.

4.1.3 Remedy Description

The ROD specified a remedy for the Site to address both soil and groundwater.

<u>Soil</u>

The soil remedy component consisted of excavation of contaminated soil, verification sampling, and transport of the soil to a permitted RCRA hazardous waste landfill. In the ROD it was assumed that some or all of the contaminated soils were hazardous wastes, as defined under RCRA.

Surface soil in the area of soil contamination (Appendix 1, Figure 2) was excavated until the remaining (i.e. below-grade) soil achieved the soil RGs. Subsurface soils, below 2 feet, were to be excavated until groundwater-protection RGs were met, but very little excavation below 2 feet proved necessary. Prior to excavation, soil sampling was conducted to confirm the areal extent of soil exceeding standards.

None of the excavated soil tested as hazardous waste, and all of the contaminated soil was transported to a RCRA Subtitle D facility contracted to EPA's Soil RA Contractor (Bechtel Environmental). The total volume removed was approximately 380 cubic yards.

<u>Groundwater</u>

The groundwater remedy described in the ROD included extraction of contaminated groundwater from the shallow and intermediate portions of the aquifer; physical treatment to remove inorganic COCs, air/gas/steam stripping to remove organic COCs, and discharge of the treated water to a local Publicly-Owned Treatment Works (POTW). The POTW considered in the FS was the City of Greer Commission on Public Works, or "CPW." The requirement for removing inorganic COCs was removed by an Explanation of Significant Differences issued in 1994.

In addition to the standard PTS components, the design, construction and operation of a groundwater extraction and treatment system, the remedy included development and implementation of a Site monitoring plan to monitor the remedy. The groundwater RGs (listed above) were to be achieved at all of the extraction and monitoring wells on or associated with the Site (i.e. the point of compliance is the entire site).

Contaminated groundwater was to be routed through an air-, gas-, or steam stripping unit to remove or reduce the concentrations of VOCs, and then routed through an activated carbon "polishing" unit, to remove any VOCs not stripped out and to provide secondary, back-up capability to the stripping unit. The 1994 ESD modified this planned treatment scheme by allowing for a different specific type of treatment if acceptable to CPW. During RD it was determined that activated carbon canisters would best perform the necessary COC removal.

Following treatment, the groundwater was to be discharged to an industrial sewer or other appurtenance of the local Publicly-Owned Treatment Works (in this case, the CPW).

Discharge to the CPW would be required to comply with all applicable City of Greer industrial pretreatment requirements.

Remedial design included the design of the treatment system described above, as well as the necessary pipelines, electrical lines, pump systems, treatment equipment, treatment facility, and other appurtenances as required.

The ROD stated that the goal of the RA is to restore groundwater to its beneficial use as a drinking water source. It acknowledged however that the remedy's ability to achieve the RGs at all points throughout the area of the plume cannot be verified until the extraction system has been implemented, modified as necessary, and plume response monitored over time. Potential contingency measures were listed to include pulse pumping to allow aquifer equilibration and encourage adsorbed COCs to partition into groundwater; alternating pumping wells to mitigate stagnation points; and installation of additional extraction wells to facilitate or accelerate cleanup of the COC plume.

In the event of a determination that the RGs could not be met, the ROD indicated that a range of management strategies would be considered, to include engineering controls such as physical barriers; long-term gradient control provided by low level pumping, as a containment measure; waiver of chemical-specific ARARs for the cleanup of certain portions of the aquifer based on the technical impracticability of achieving further COC reductions; the use of institutional controls to restrict access to those portions of the aquifer that remain above RGs; continued monitoring of certain wells; and periodic re-evaluation of other, new remedial technologies for groundwater restoration.

4.2 Remedy Implementation

4.2.1 Soil Remedial Action (RA1)

Following a very short design phase, mobilization for the field excavation activities to accomplish the source control remedy component, addressing surface soil contamination, began on August 9, 1994. Work was completed on September 12, 1994. Soil within the affected area was excavated in 1-foot lifts until the remaining soil met the established RGs. TCLP samples analyzed by EPA prior to field work established that the surface soils did not test as hazardous wastes. A total of approximately 380 cubic yards of soil was removed from the Site and transported to Sandy Pines Landfill (Subtitle D), in Dorchester County, South Carolina, for disposal. The excavation was backfilled with clean soil, properly recompacted, the land surface regraded, and vegetation reestablished to minimize erosion.

4.2.2 Groundwater Remedial Design (RD2)

Remedial Design was initiated in July 1993 and completed in September 1995. Initially, EPA attempted to establish a "performance criteria" approach rather than a more standard, "design-specification" RD. This effort was ultimately found to be unsuitable for Site conditions, and a straightforward design process was completed between 1994 and 1995. RD activities included further investigation characterizing the extent of groundwater contamination and aquifer properties. A number of additional wells were installed in April-May 1995, and several pump tests were conducted. Initiation of Remedial Action activities was delayed for one year between October 1995 and October 1996 due to federal budget problems.

Site groundwater monitoring, a remedy component, was performed by EPA and its contractors between 1993 and 1995. During the period of federal budget problems, EPA used in-house resources to continue periodic monitoring of groundwater conditions until Bechtel assumed this task as part of the RA in 1996.

4.2.3 Groundwater Remedial Action (RA2) Construction

The RA was initiated in October 1996. As designed, the groundwater pump-and-treat system (PTS) included nine (9) pumping wells and one spring sump, which capture the contaminated groundwater and direct it to an onsite treatment unit (activated carbon). After treatment the water is discharged to the City of Greer's sanitary sewer (Greer CPW) under an Industrial Pretreatment permit. The spring sump was later converted to an extraction well as an operational improvement (section 6.1.1).

The PTS pumping wells are arranged into two, approximately parallel, lines, reflecting the deeper groundwater contamination found in the northern portion of the Site. Figure 4 is a conceptual figure showing, in cross section, the overall model of groundwater and contaminant transport that was used in designing the PTS. The figure reflects the pattern of shallow contamination to the south, closer to the former Elmore property, and deeper contamination observed in wells farther to the north, which was observed during the RI/FS and RD.

Figures 5 and 6 illustrate the layout of the PTS within the Sunnyside Circle portion of the Site. On the "South Line" (Figure 5), wells are screened in the shallow zone, pumping from about 20 to 50 feet below grade. "North Line" wells (Figure 6) are screened in the intermediate zone, pumping from about 50 to 80 feet below grade.

The PTS is controlled by a electronic, remote-control, programmable logic controller (PLC) unit, manufactured by Bisco Environmental Inc. and made specifically for use on environmental remediation sites. The PLC enables the system to report well water levels, pumping status, system alarms, and other data in real-time, via telephone line, back to O&M personnel at remote locations. At the Site, portable computers can also be used to access the system and record data.

EPA's RA Contractor, Bechtel Environmental, began contracting activities to secure an RA subcontractor, culminating in issuance of a Bid Package in February 1997. RA Subcontractor Earth Tech was selected in June 1997. After subcontract work-planning activities were completed, on-site field work began in October 1997. Construction activities set forth in the September 1995 Final RD Report (as well as the RA Subcontract Statement of Work), and completed during RA construction, included:

Supplemental investigation and well installation activities on the North Line (most downgradient extraction wells), to include deeper zone test boreholes and analysis of samples, followed by installation of three extraction wells (October 1997-December 1997);

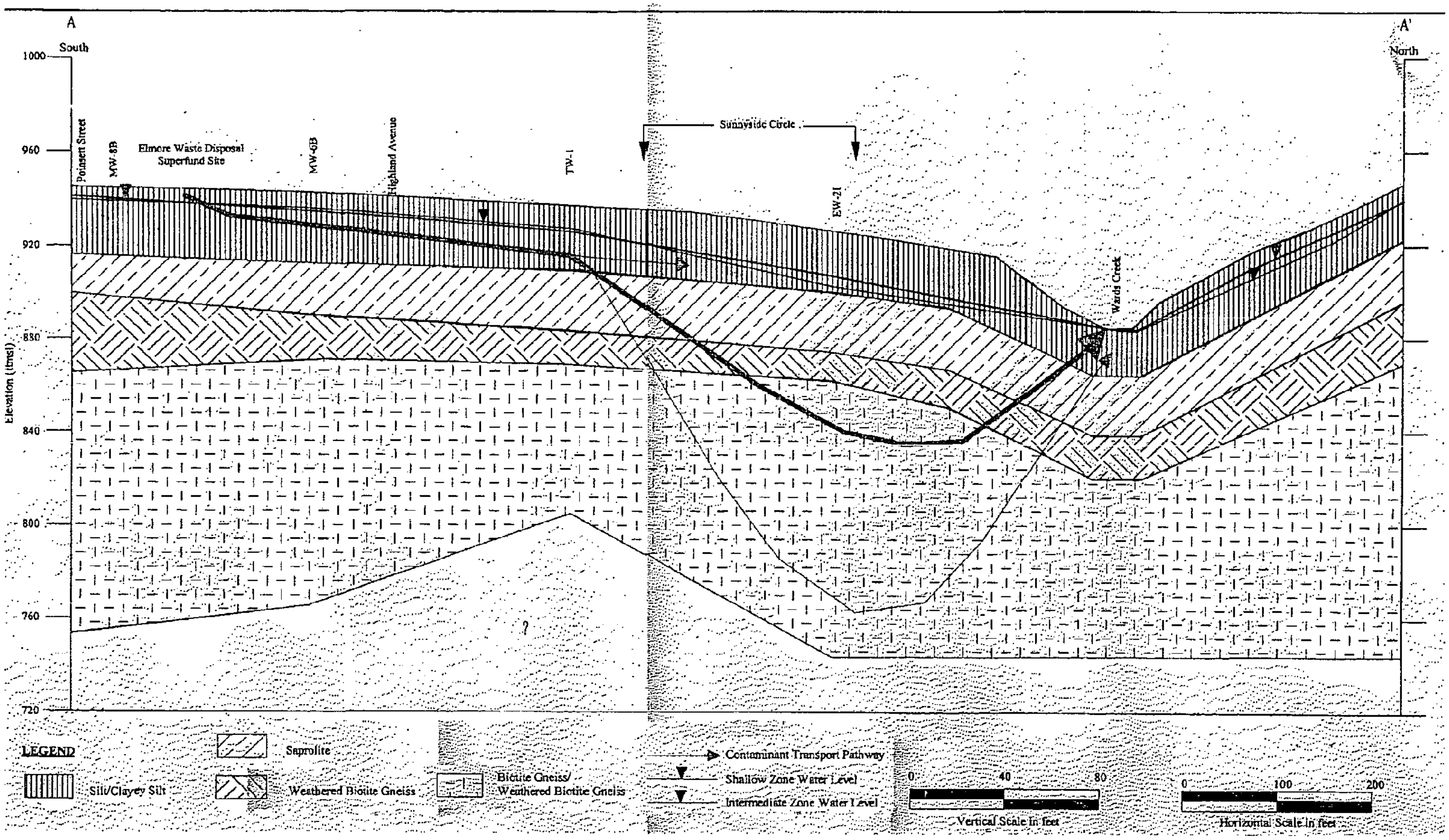


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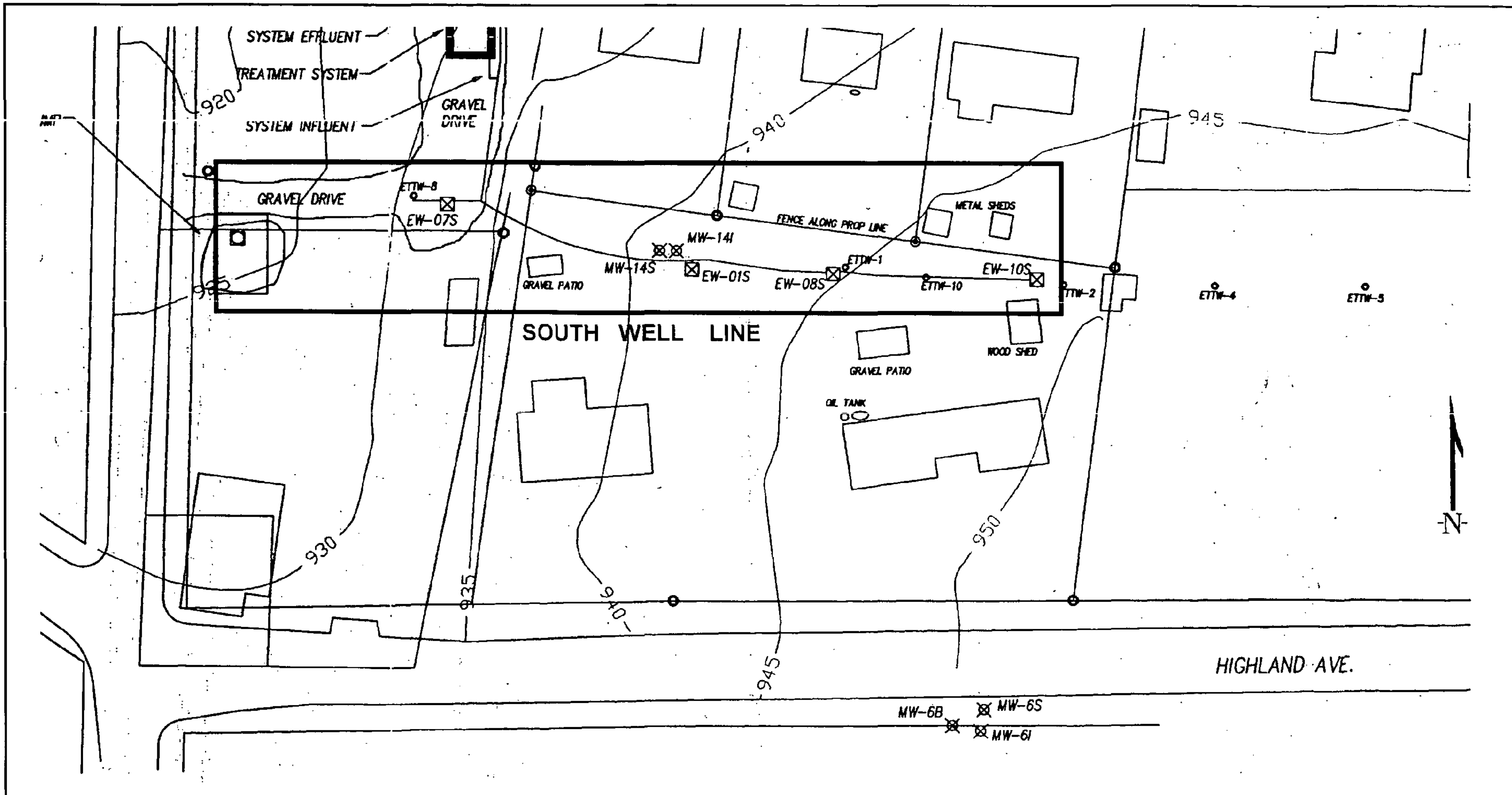
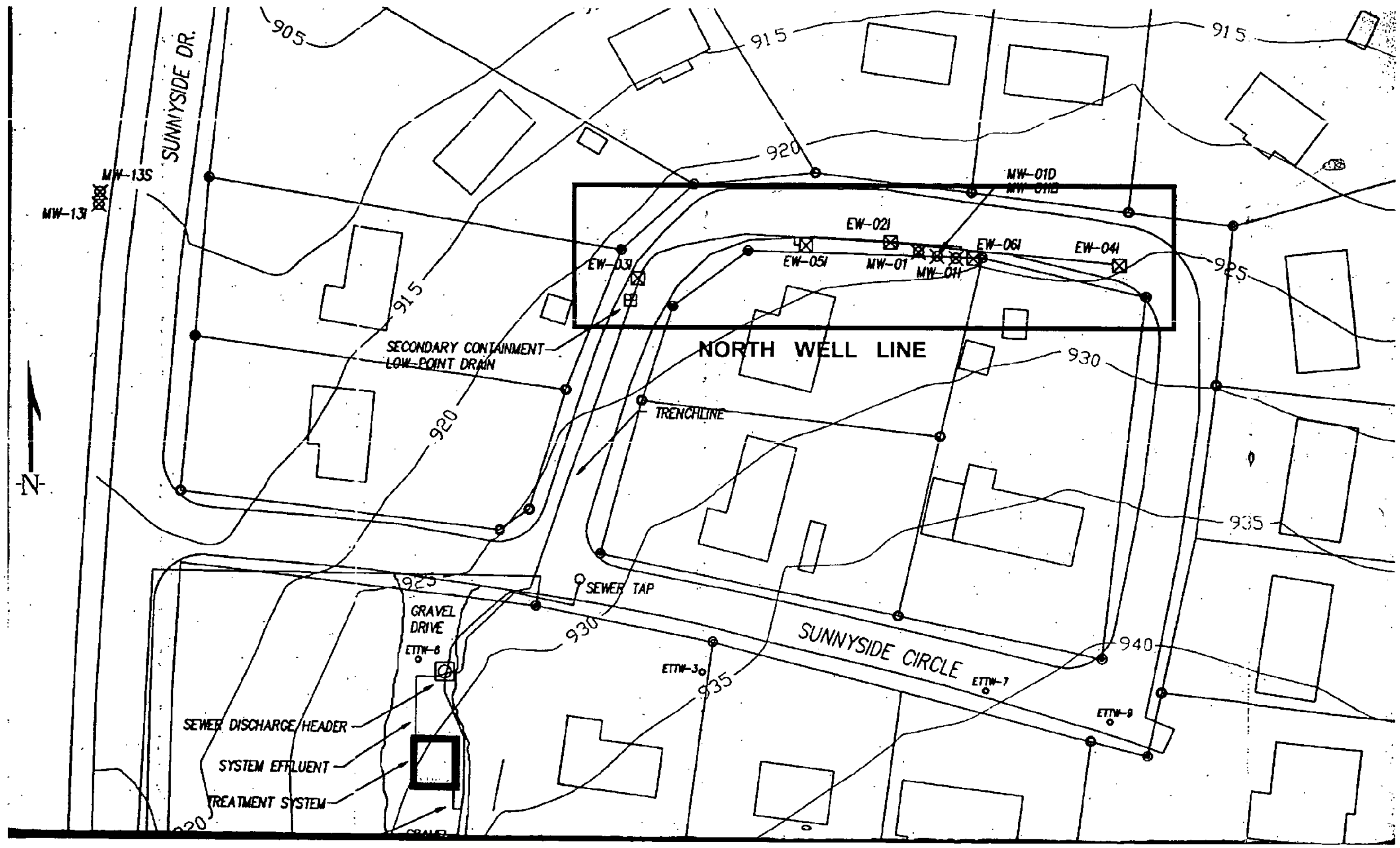
FIGURE 4
Conceptual Site Groundwater Flow Paths

(Adapted from Bechtel, 1998, "Three Dimensional Groundwater Flow and Contaminant Transport Model")



Five Year Review Report **Elmore Waste Disposal Superfund Site** **September 2003**	**FIGURE 5** **RD Map of Site Area (South Well Line)**



Five Year Review Report **Elmore Waste Disposal Superfund Site** **September 2003**	**FIGURE 6** **RD Map of Site Area (North Well Line)**

Installation of North Line pumps, lines, controls, electrical supply, and well instruments (January 1998);

Completion of Final RD based on investigatory work (North Line) and initial pumping of wells;

Installation of South Line wells (5) and pumps, lines, controls, electrical supply, and well instruments, as well as three (3) additional North Line wells (April 1998);

Installation of water treatment and water handling equipment on-site, to include construction of the treatment building, installing power, sewer, electrical, controls and instrumentation (June-July 1998); and;

Initial test-pumping and troubleshooting operations prior to full start up of operations (August - September 1998).

While Earth Tech constructed the PTS, Bechtel completed additional shallow-zone groundwater sampling in May 1998 to better define the area and volume of contaminated groundwater and to confirm the placement of North and South Line extraction wells. Additionally, groundwater modeling by Bechtel in late 1997 and 1998 was used by Earth Tech and Bechtel to determine the optimum placement and spacing of the extraction wells.

4.3 System Operations and Maintenance

4.3.1 Operations

After a "shake-down" period during the summer of 1998, the PTS became fully operational in September 1998. Bechtel's subcontractor Earth Tech performed the first quarter of system O&M, with Bechtel taking over for the next two quarters (January-June 1999). Despite the lessons learned from the summer's initial operations, the first two quarters of the system operations were expensive (table 4 below), mainly due to problems with faulty alarm mechanisms and other problems with the PLC unit. Eventually it was shown to be more cost-effective, for about 4-1/2 months, to have Bechtel's system technician lodge and remain in the Site area, although this need passed as adjustments and changes (most at low cost) were made to the system.

During 1999 EPA Region 4 changed over to a new contract vehicle, the "Remedial Alternative Contracting Strategy" (RACS) to be used to execute all Superfund site work. Following a competitive process, Black & Veatch was awarded the RACS contract for Region 4. Accordingly, in July 1999 Black & Veatch took over the O&M work assignment for the Elmore Waste Disposal Site. There was a gap in PTS operations between June 21, 1999 and September 13-17, 1999, when Black & Veatch re-started the PTS and monitored the system's performance.

Black & Veatch utilizes its RACS-contracted "team subcontractor" Shaw Environmental & Infrastructure, Inc. (Shaw E&I) to perform the Site visits and work necessary to operate the PTS. Shaw then reports the appropriate information to Black & Veatch, responsible in turn to EPA.

The routine for operating the system has evolved into twice-weekly operator visits from an assigned Shaw environmental technician, who performs a variety of "routine" and occasional "non-routine" tasks. Routine tasks are collecting system flow meter/discharge data, walking the system to check for damage or leaks, pulling and inspection of submersible pumps (2x annually), monitor pump amperages, maintain stock of spare parts (<$500), inspect treatment building components (tank, water level sensor, transfer pump, carbon canisters), inspect/change bag filter, periodic back-wash of the carbon canisters, and responding to system-alarm conditions if the problem cannot be corrected remotely (telephone). "Non-routine" visits represent extra Site visits and ongoing repair of PTS components or equipment, if any are ongoing. A major focus of the O&M work has been to anticipate and reduce the amount of non-routine work required each year, and this has largely been achieved.

A monitoring and reporting program is in place to include weekly, monthly and annual reports. Weekly reports are brief, focusing on Site observations, water flow data, and providing written (email) notice of potential problems. Weeklies are gathered into monthly reports, also brief and provided via email, that provide a monthly perspective on PTS performance. Photographs are used to good effect, to show Site conditions and activities.

Quarterly and annual reports are prepared to document PTS operations, performance and progress toward Site cleanup goals. The reports also contain the analytical results from each quarter (or year, in annual reports). Quarterly sampling currently includes 15 monitoring wells, 2 piezometers, all 10 pumping wells, and 4 surface water samples. Annual monitoring includes these same data points plus an additional 6 out-lying monitor wells (for a total of 21). EPA is considering adding several of the 12 piezometers installed in 2003 to the monitoring program.

Discharge operations include analytical monitoring of system influent (from the pumping wells) and effluent (post-treatment) contaminant levels. Reporting of this data to the City of Greer CPW is required, monthly, along with system water flow/discharge data. There have been no problems with compliance with CPW's requirements. The Site permit allows discharge to the CPW sanitary sewer system of 50,000 gallons per day from the PTS.

In general, the PTS has operated as it was intended, and the various system components have performed fairly well. An evaluation of the PTS, on the criteria of *operations* and *performance,* is presented in the technical assessment (Section 6).

4.3.2 Anticipated and Actual Annual Costs

The 1992 FS projected a likely annual groundwater PTS O&M cost of approximately $97, 000 per year; however, it assumed a six-pumping-well system and only 30 gallons per minute treated. An estimate of $ 200,000 per year was generated for the Final Remedial Design by Bechtel in 1995, the estimate having less uncertainties associated with it. With the PTS built and operating, a more accurate estimate was prepared by Black & Veatch, the current RA Contractor, in September 1999 for the Final O&M Work Plan. Excluding the revision of work plans, which was complete by that time, the anticipated costs for 2-3/4 years of operation was estimated at $449,000, or $163,000 per year (roughly equal to $13,600 per month).

As noted above, the actual costs for the last quarter of 1998 and first three quarters of 1999 were greater than in subsequent quarters. The expected annual O&M cost estimated by RA Contractor Black & Veatch in 1999 has proven to be accurate. Actual O&M costs since 1999 have in fact run between $11,000 and $14,000 per month (see Table 4 below) and have decreased to approximately $11,000 per month since January 2001. The costs shown below include all necessary component purchases (transducers, flowmeters, pumps and pump components) and one change-out of the carbon canisters.

Table 4: System Operations/Maintenance Costs

Dates		Total Cost ($1000s)
From	To	
September 1998	December 1998	129,000
January 1999	June 1999	166,000
June 1999	December 1999	56,000[1]
January 2000	December 2000	151,000
January 2001	December 2001	130,000
January 2002	December 2002	130,000[2]
January 2003	June 2003	70,000[2]

Notes
1. 1999 cost does not include one-time planning costs (work plan prep/approval) required by contract but not necessary to run system.
2. 2002 and 2003 costs do not include investigative/characterization costs conducted as optimization work (new wells, pump testing, etc.)

SECTION 5 Five Year Review Process

5.1 Components of the Review

In accordance with guidance, a review team was established to review and comment on the Five Year Review as summarized in this document. Members are listed below:

Name	Affiliation	Role
Ralph O. Howard, Jr.	EPA Region 4, Waste Management Division	Project Manager (PM), Five Year Review preparation
Minda Johnson	SCDHEC, Bureau of Land and Waste Management, Columbia SC	State review (Support Agency) role under CERCLA
Dave Jenkins	EPA, Waste Management Division	Hydrogeology review
Stephanie Y. Brown	EPA, Waste Management Division	Community Involvement
Ed Hicks	Black & Veatch Special Projects Corp.	O & M Contractor for EPA

A draft version of this Five Year Review Report was circulated to review.team members during August and September 2003. All comments generated from their review have been addressed and incorporated herein.

A Site Inspection was conducted, formally, to support this Five Year Review on June 11, 2003 (see below). However, it should be noted that the RPM, State Project Manager, and the O&M Contractor have all visited the Site on many occasions and on a regular basis, so there was no need for re-familiarization of team members to the Site.

5.2 Community Involvement

During the time of the review, two advertisements were placed in the Greenville News and the Greer Citizen, which ran on Friday, July 17, 2003 and Sunday, July 20, 2003 (Appendix 2). Earlier in the year, the Five Year Review was discussed briefly at a Public Availability Session held near the Site on February 20, 2003. While the session focused mainly on the work EPA had undertaken to investigate potential indoor air contamination related to the contaminated groundwater underlying most of the Sunnyside Circle neighborhood, the larger optimization project was also described, along with the Five Year Review topic. The scope of the planned work was emphasized, to include installation of additional monitor wells and piezometers, shallow aquifer sampling using Geoprobe, and aquifer pump testing. No public comments or questions were received during the conduct of the Five Year Review. Another Public Availability Session regarding crawl-space (and potentially indoor) air contamination is planned for early October 2003, and EPA will use the opportunity to describe the findings of this Five Year Review Report.

There has been a steady level of public interest in the optimization work beyond those residents living near the Site, as evidenced by a series of articles in the Greer and Greenville newspapers, and occasionally the Spartanburg newspaper, since 2001.

5.3 Site Inspection

On June 11, 2003 a Site Inspection was conducted at the Site to support this Five Year Review, as well as to discuss ongoing optimization work with State agency personnel. Appendix 3 contains the completed Site Inspection checklist.

The RPM and attendees completed a walk-through of the Site and nearby areas to the south, including the original Elmore Site property. Two changes to Site conditions were noted from visits in previous years. The first was that the four small row houses formerly located on an adjoining property parcel along the western edge of the former Elmore parcels (along Sunnyside Drive) have been removed. These homes bounded the area of the 1994-95 Soil RA portion of the Site remedy. Also noted was the completion of a three-unit duplex apartment building located just to the west of the treatment building. The treatment building is located within a 25-foot easement strip along the east boundary of this property parcel.

Due to the participants' familiarity with the Site, the walk-through focused on the locations and placement of the new piezometers being installed as part of the Site's ongoing optimization work, which is further described in section 5.5 below.

5.4 Documents and Data Reviewed

A variety of documents were reviewed in the preparation of this report (Table 5).

Table 5: List of Documents Reviewed

Document Title, Date	Author
Baseline Risk Assessment Report (1992)	Black & Veatch
Record of Decision (1993)	EPA
Final Remedial Design Report (1995)	Bechtel Environmental
Explanation of Significant Differences, Elmore Waste Disposal Site (EPA, 1994)	EPA
"Three Dimensional Groundwater Flow and Contaminant Transport Model, Elmore Waste Disposal Site" (1998)	Bechtel Environmental
Preliminary Close Out Report, Elmore Waste Disposal Site (EPA, 1998)	EPA
Interim Remedial Action (RA) Report, Elmore Waste Disposal Site (Bechtel, 1999)	Bechtel Environmental
Final O&M Work Plan (Black & Veatch, 1999)	Black & Veatch
Quarterly Monitoring Reports, 4th Qtr 1998 and 1st Qtr 1999	Bechtel Environmental
Quarterly Monitoring Reports, 2nd Qtr 1999 to 1st Qtr 2003	Black & Veatch
Statement of Work for RA Operations and Maintenance, Elmore Waste Disposal Site, March 2001, Amendment 01 - March 2001 (EPA, 2001)	EPA
Superfund State Contract (1999)	EPA
"Remedial System Evaluation Report, for the Elmore Waste Disposal Superfund Site, Greer, South Carolina," Final Report, April 2001	US Army COE; EPA Technical Innovation Office (TIO), EPA Headquarters

5.5 Remedial Systems Evaluation (RSE) and Project Optimization

In 1999, the US Environmental Protection Agency's (USEPA) Technology Innovation Office (TIO) and the US Army Corps of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW-CX) initiated a cooperative project intended to demonstrate the USACE's "Remediation System Evaluation" process at Superfund sites. The RSE demonstration was part of a larger effort by TIO to provide EPA Regions with access to computer modeling and other pump-and-treat system optimization tools, and to identify sites likely to benefit from optimization.

Many EPA Guidance documents for pump-and-treat technology acknowledge that periodic re-evaluation and optimization of groundwater pump-and-treat systems is both typical and required. In light of this the RPM had planned for an "optimization" task in the O&M, but upon discovering the Remediation System Evaluation project, enrolled the Elmore Site in order to access the considerable expertise available from RSE participants. Candidate sites were screened by EPA Headquarters with a focus on pump and treat systems managed by EPA Region 4 that had significant operational costs and a long projected operating life.

To conduct the review, a team consisting of scientists and engineers reviewed a large number of Site documents during 2000. This was followed by an onsite inspection conducted on September 19-20, 2000. The RSE Report (Final) was issued in April 2001 (Appendix 4).

In March 2001, in a modification of the Site-specific O&M Statement of Work, EPA initiated an Optimization Task for the Elmore Site PTS, with the goal of evaluating and later improving system performance and cost-effectiveness. The first phases of this RA Contractor work in 2002 included installing and sampling nine (9) additional confirmatory groundwater monitoring wells, installing two new shallow piezometers, sampling the creek along the north Site boundary, and groundwater flow modeling using data from the new wells, and revision of certain CPW-required sampling procedures (lab analysis). Additionally, EPA sampled soil gas at twelve locations in the main, Highland Avenue/Sunnyside Circle portion of the Site. At the end of 2002, a "Remedial Systems Optimization Report" and "Capture Zone Analysis Report" were prepared by the RA Contractor to summarize the completed optimization work and recommend follow-on work. Appendix 5, the "Remedial Systems Optimization Report,"contains a table (Table 3-1) which compares the 2001 RSE Report recommendations to completed optimization work through late 2002.

Based on these reports and EPA-SCDHEC consultation, EPA's RA Contractor performed additional work during May and June 2003 that included installing five shallow (South Well Line) and six deep (North Well Line) piezometers for better measuring hydraulic capture and conductivities, conducting two pump tests, installing one shallow piezometer along the apparent eastern shallow groundwater plume perimeter, and investigating the southeastern area of the plume. A report is to be prepared in early 2004 summarizing the new information about system performance that was generated from this work.

Considered as a whole, recent Site findings confirm that there are problems with both PTS hydraulic capture, and with incomplete plume delineation. Since these findings affect evaluations of PTS operational effectiveness and overall performance, they are considered further in sections 6.1 and 6.3 below. Continuing optimization work will focus on identifying and implementing the most effective measures to optimize performance of the pump-and-treat system.

SECTION 6 Technical Assessment

6.1 Question A: *Is the remedy functioning as intended by the decision documents?*

Monitoring reports for the Site's PTS are prepared on a quarterly basis (see example at Appendix 6) by the RA Contractor. In order to answer Question A, the sections below consider and expand upon the evaluations and findings presented in the quarterly reports, and those contained in the April 2001 RSE Report.

6.1.1 System Operations

"System operations" criteria include issues of cost, reliability and avoidance of down-time, as well as the effectiveness of current procedures to run the PTS. The 1st Quarter 2003 Quarterly Groundwater Monitoring Report (Appendix 6) is typical of the reports documenting PTS operations and Site remedial progress since 1998.

Section 2 of each quarterly report details operational problems or issues for the quarter. Review of past reports indicates that, while there have been equipment and consequent operational problems, these are not unusual for mid-sized or large pump-and-treat systems such as the Elmore Site PTS. In early quarters (1999-2000), corrosive well water was seen to cause malfunctioning water-level transducers, electric pump damage and pump fouling. There have also been the usual electrical glitches and wiring failures, although these were mostly prior to 2001. As shown in Section 3 of the March 2003 quarterly (the latest quarterly data available), more than 27 million gallons of contaminated groundwater have been treated by the PTS during these 18 quarters (4.5 years). Review of this and past quarterly reports indicates that, with occasional exceptions (described below), system pumping rates and overall pumping efficiencies have been consistent and uninfluenced by short-term problems at individual wells.

For the five-year period overall, there have been two significant operational problems. The first was the poor performance of the Spring Sump (EW-09). During and after the first few months of operations, the spring sump generated extensive fine-grained sediment which caused the transducer and flowmeter to require almost constant maintenance. Also, sediment loading from the sump necessitated an inordinate frequency of bag-filter cleaning. In March 2000, after considering the constant mud production and analytical results showing below-RG levels of Site COCs, EPA ceased pumping from the spring sump until August of 2001. As part of the PTS optimization field work in May 2002, a 30-foot, 4-inch diameter shallow extraction well was installed through the bottom of the sump structure. A new pump was purchased and installed. After some electrical supply problems were resolved, the well came fully online in October 2002.

Pumping from this location was originally intended to both capture contaminated groundwater, and to prevent the possibility of exposure to surface water (spring-fed) containing Site COCs. However, analytical results continue to indicate contaminant levels near the RGs. Residents indicate that in the past the spring was dry only rarely, and PTS experience has verified that the yield from EW-9 is significant. Thus the well contributes only relatively dilute water and no contaminant mass. The issue of whether EW-9 should be pumped at all, and/or how to deal with the potential re-emergence of the former spring, will have to be resolved as part of the ongoing optimization project.

The second issue was the performance of the PLC system control unit. Problems included lightning vulnerability, surges from "unfiltered" electrical supply, and others. The worst effect of these problems was a four-month downtime period (October 1999-February 2000) for six pumping wells. Technical representatives of Eos Research, which sells and services the Bisco "ProControl" controller unit, provided significant low-cost assistance to the RA Contractor in getting numerous problems corrected.

Various operational problems with electronic transducers, which record water-level data, have been corrected by adherence to cleaning schedules. In December 1999, a loose ground, which caused the high-level sensor switch to malfunction, was repaired. An early problem with the high-level alarm and the equalization tank was resolved through installation (in 2000) of a larger, 525-gallon tank to replace the original 300-gallon tank.

As noted in Section 4.3, O&M costs were estimated in 1999 to be approx 13,600 per month, and have ranged between $11,000 and $14,000 per month. O&M costs have included all of the necessary component purchases (transducers, flowmeters, pumps and pump components) and routine periodic expenses, such as the change-out of the three carbon canisters. Carbon canister change-out was last done in 2001, and will likely be needed again during the upcoming fiscal year (2004). It is anticipated that an additional O&M cost to be incurred next year will be the possible replacement of the PTS logic controller unit (PLC). After the initial problems described above were corrected, the unit performed reasonably well, and assuming a newer more capable unit performs likewise, the anticipated cost ($15,000 for five years) does not significantly alter the annual O&M costs.

The RSE report recommended seven operational changes related to system operations (Appendix 5, those numbered 5-11). These do not bear directly on protectiveness, but would contribute to increased system efficiency. One recommendation (#7), to eliminate certain types of sample analysis, has been partly implemented through reduced requirements that were approved by the Greer CPW. Another (#11), concerning well production goals, is under active consideration in ongoing work. The others are being retained but cannot be acted upon at present.

The RA Contractor has worked diligently to work Site operations into a steady and predictable routine, resulting in steady and predictable costs. PTS operation has benefitted from the use of experienced technical staff at the RA Contractor's subcontractor (Shaw E&I, Inc.) Greenville, South Carolina office.

6.1.2 System Performance

The performance criterion includes considering water flow or pumping efficiency, as well as the efficiency of the mass removal of contamination, and the effectiveness of the PTS' hydraulic capture of contaminated groundwater.

As noted above, between PTS start-up in 1998 and March 2003, more than 27 million gallons of contaminated groundwater have been treated by the PTS. Considering the last six quarters (1.5

years), typical quarterly flow (combined system total) is approximately 1.5 million gallons. A period of draught proior to 20002 resulted in periods of less flow, however, prior to 2002.

Potential problems with well yields and hydraulic capture were identified in the 2001 RSE Report and have been further investigated. As noted in the RSE Report, the PTS wells are not maintaining the yields assumed in the Final RD, and thus may not be capturing contamination adequately along either well line (North, South). Considering new well sampling results and samples from the creek bed of Wards Creek, the Capture Zone Report (November 2002) concluded that capture is inadequate along both lines, and indicated that certain pumping wells may not be capable of yielding the necessary volumes, while for others it recommended certain changes intended to increase yields. Changing the positions of the water-level sensors (which control the on-off pumping cycle) has given some yield improvements. However, it is not yet clear that the improvements are adequate, or what yields are actually necessary for complete plume capture. Partly this is due to the lack of enough hydraulic conductivity data, which are critical inputs for supporting accurate groundwater modeling. This has been addressed through installing new data points (wells, piezometers) which can now be used for direct measurements and testing. Further work to improve both yields and capture is planned.

The inadequate well yields described above have resulted in result in under-utilization of the available capacity, for treated-water discharge, permitted by the CPW. Comparing the average quarterly groundwater flow (1.5 million gallons, or 16,667 gallons per day) with the CPW's discharge limit (50,000 gallons per day) , indicates that additional capacity (although limited) exists which may support any necessary PTS modifications identified in optimization work.

The O&M quarterly reports (Appendix 7, section 4.3) track rates of COC mass removal. Typical quarterly mass removals (6-quarter average) are 10 pounds of trichloroethylene and 9 pounds of tetrachloroethylene, along with approximately 0.7 pounds of other VOCs. These recovery rates (amount per quarter) have remained fairly constant. In terms of trends and decreasing concentrations, the most noticeable have been the 2001-02 increase of COC levels in the easternmost extraction well EW-10, although the last three quarters have seen a decrease. Other wells have had mixed changes and their interpretation is unclear. At the south end of the contaminant plume, shallow well MW-6 has steadily decreased since 1998, reflecting decreasing contamination in that area. Overall, a gradual decrease in system influent levels (that is, the total level of COCs collected by the wells) has been observed in annual total VOC averages of each year's quarterly samples, as shown below:

Year	Average of quarterly influent samples (mg/L)
1999	4.01
2000	2.25
2001	1.96
2002	2.16
2003	1.15

Note: *only two measurements available for 1999.

In considering contaminant mass removal, the 1st Qtr 2003 quarterly report (Appendix 6) shows that 489 total pounds of Site COCs have been removed by the PTS. As with many groundwater contamination sites, since the amount of COCs present in groundwater at PTS startup is not known, a mass-balance calculation of the PTS' operating, effective mass removal rate cannot be performed. However, the relatively low influent concentrations into the PTS (below 1.5 mg/L total Site COCs) suggest that gaining an improvement in mass-removal efficiency may be possible through targeting certain wells for additional pumping, replacing wells at which yields cannot be increased, adding wells to capture across the full plume width (as discussed below), or possibly other means.

Optimization work findings in 2002-03 indicate that the PTS is probably not centered on the main flow axis of the plume, contradicting earlier Site work (during RD) that indicated a shallow plume boundary closer to EW-10S, the easternmost shallow pumping well and thus the current limit of shallow groundwater capture to the east. EW-10S currently has the highest COC concentrations, which have been increasing for several quarters. COC levels at well MW-6, by contrast, have been declining since PTS startup in 1998. In addition, recent results from the June 2003 shallow groundwater samples taken using a Geoprobe unit, in the southeast portion of the Site, along and south of Highland Avenue (Figure 3), confirm that the plume boundary is located some 100 or more feet east of its earlier, apparent edge. To restore effective mass removal, at least one additional pumping well, and perhaps more, will be needed on the South Line to achieve capture. Additional implications from the Geoprobe sampling are considered in section 6.3 below.

Likewise, on the North Line, 2002 sampling of new intermediate/deep well MW-18D, located east of well EW-4I, indicates that contamination is escaping the influence of the intermediate-depth PTS system in the east direction. Pump-test data from this well will be used to determine a suitable extraction well configuration that will improve capture along the North Line.

RSE Report recommendations that concern performance issues (Appendix 5, Table 3-1, those numbered 1 through 4) are being pursued in the optimization task of the Site O&M.

6.1.3 Institutional Controls

Institutional controls were not part of the Site remedy for soil. Exposure sufficient to cause any long-term excess risk would require that the area of replaced surface soil on the former Elmore property be re-excavated, and this surface, located some 2 feet below grade, be used for gardening on a regular and extended (long-term) basis. This is not realistic or possible given the prevailing land use for homes, apartments, shops, and similar uses.

For groundwater, institutional controls (ICs) were included in the remedial alternative selected in the ROD, but none have ever been formally implemented across the entire Site. Deed restrictions and well permit restrictions were described, although the restrictions were described as being written into property deeds. During RA construction (1998) EPA purchased, from three homeowners, four (4) property easements, which are narrow strips that encompass the entire South Line of pumping wells. The deeds of these homes do contain easement language which detail certain land use restrictions. Concerning water well use, a "governmental control" type of IC is in place through the well permitting authority exercised by SCDHEC through its regional

(Appalachia III District) office. In short, water well drillers cannot install a well without prior approval from SCDHEC.

Also, to prevent potential exposures through groundwater and surface water use, EPA and its Contractors have established ongoing contact with Site residents. Because of regular community contact, neighborhood residents and nearby homeowners in the area are well aware of the ongoing pump-and-treat work. In summary, ICs should not be necessary under current use conditions, or any foreseeable future use. ICs should be reevaluated in the future if a significant remedy change is considered.

6.1.4 Optimization of the PTS

As discussed in preceding sections, the O&M in progress at the Elmore Waste Disposal Site has an ongoing task consisting entirely of further PTS optimization work, to improve both operational efficiency and environmental effectiveness (contaminant mass removal, protectiveness). All of the PTS issues identified and discussed in sections 6.1.1 and 6.1.2 can be resolved through appropriate investigation followed by system improvements and upgrades.

6.2 Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection, still valid?*

6.2.1 Cleanup Standards and TBCs

A review of the ROD indicates that none of the listed cleanup standards and criteria have changed in a manner that would affect remedy protectiveness. Soil cleanup standards were achieved at the time of the 1994 Soil RA. For groundwater, the primary standards were the Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act, which are unchanged. As noted, the MCL for methylene chloride was finalized after the 1993 ROD.

6.2.2 Risk Assessment Criteria

Toxicity factors for Site COCs have not changed since the ROD, although the IRIS toxicity values assigned to trichloroethylene (TCE) and tetrachloroethylene (PCE) are currently under review at EPA Headquarters. Even if altered, Site groundwater COCs include compounds other than these two, so that there is no practical effect.

Land uses in the Site area, and the exposure scenarios considered in the original Baseline Risk Assessment (BRA) and ROD, have not changed since the 1993 ROD. In terms of exposure to COCs through other pathways than groundwater consumption, which is not occurring, exposure of children playing in Wards Creek was assumed in the BRA. However, neither carcinogenic nor non-cancer risk exceeded the 1×10^{-6} or HI = 1.0 risk benchmarks, respectively, even conservatively assuming 12 weeks of twice-per-week swimming, per year. EPA and RA Contractor personnel have had only rare sightings of children or adults having any contact with Wards Creek, and no swimming has been observed at any time.

However, a previously unrecognized exposure pathway came to light in 1994, during RD work. The groundwater-to-indoor-air pathway, more recently termed "vapor intrusion," had not been considered in the 1992 BRA.

Shallow depths to groundwater had been noted at several wells. Considering this together with then-new Agency experience with indoor air contamination at TCE/PCE groundwater sites, EPA conducted a crawl-space air sampling event at three (3) homes in Sunnyside Circle in July-August 1994. The three homes sampled were selected based on groundwater analytical data placing them close to significantly-contaminated groundwater. No indications of long- or short-term risks to human health were found. However, the 2001 RSE Report recommended that additional sampling be performed, on a larger scale and under more homes (Site boundaries encompass 20 homes, 3 along Highland Avenue and 17 in Sunnyside Circle). Soil gas sampling was completed in 2002, followed by crawl-space air sampling at 17 of 20 neighborhood homes in May 2003. Results from that effort are currently in review.

Although not recognized at the Site in 1993, the existence of the groundwater-to-indoor-air pathway is unlikely to have altered the selection of pump-and-treat technology for groundwater, or the design of the PTS. If necessary, simple and reliable remedial measures to reduce or eliminate vapor intrusion (vapor blockage, fans, others) can be installed at any affected residences to mitigate potential long-term risks. As long as any necessary measures are taken, the vapor intrusion pathway should not affect remedy protectiveness.

6.2.3 Progress Toward Site RAOs

Considering the Site's remaining cleanup objectives (those numbered 1, 2, and 5, listed at section 4.1.2), which concern groundwater, the ROD and RD anticipated that measuring progress toward RAOs would require a long period of time, because of the nature of most pump-and-treat remedies.

Prior to the start (2001) of ongoing optimization work, available data such as the very low COC levels detected in Wards Creek and steady rate of COC mass removal from groundwater had suggested the PTS was performing generally as expected. As noted the PTS has removed almost 500 pounds of COCs from the affected aquifer. However, findings from the optimization work to date, as described above, suggest that in spite of PTS operations, progress towards the RAOs is probably being limited. To achieve further progress will require that the PTS shortcomings described in sections 6.1.1 and 6.1.2 be resolved through further investigation followed by system improvements and upgrades.

6.3 Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

Results from optimization work since 2001 have demonstrated that the PTS has significant performance issues that must be addressed. Sections below further discuss the issues, recommendations and follow-up actions planned for the Site.

Certain new information resulting from the groundwater sampling conducted in June 2003 (section 6.1.2) was highly unexpected and may have implications for long-term PTS effectiveness and protectiveness. Concentrations of TCE and PCE, the two main Site COCs, were much higher at locations on the former Elmore Site than anticipated. Location A6, in particular, has more than 9 mg/L combined TCE and PCE. This amount suggests that the presence of dense non-aqueous-phase liquids (DNAPL) cannot be ruled out, and that a contaminant source may also be present. Assuming DNAPL is not present, new pumping wells could be used to better capture the affected groundwater; however, the current well configuration is not adequate to do so. If DNAPL is present, it may be necessary for EPA to modify the Site remedy to employ, at least in the A6 area, a different cleanup technology than was selected in the ROD. There is no observable evidence of contamination in surface soil, and thus no surface exposure, in the area around A6. In order to ensure long-term protectiveness, the area around A6 will be further investigated to determine the necessary PTS changes, soil or waste removal, or other response action, if needed.

6.4 Technical Assessment Summary

Review of the Site remedy as implemented since the 1993 ROD indicates, in summary, that the Site PTS is operating as originally designed in the RD (1996-98), but needs improvement in its effectiveness and efficiency in order to perform as intended by the ROD and the RD.

The *operational* issues identified by the 2001 RSE Report and subsequent optimization work should be pursued, but do not bear on long- or short-term protectiveness. Operational problems can most likely be resolved through continued improvements. The operational limitation on discharge to CPW (50,000 gallons per day) may be a factor in making changes to the PTS.

The identified *performance* issues, however, are significant and probably impact long-term protectiveness. Current data indicate that some contaminated groundwater discharges solely to Wards Creek, rather than escaping beneath it offsite. However, this needs to be verified with additional information. Some escape of contaminated groundwater offsite to the northeast is also evidenced by deep well MW-18D. These findings indicate that the horizontal and vertical extent of contamination must be further investigated in order make the necessary changes to PTS configuration and capabilities, which in turn will allow adequate capture to be achieved. Although there is no known groundwater use nearby, ensuring long-term protectiveness will require that these actions be completed.

Standards and risk criteria have not changed in any significant way. There is no short-term exposure present at the Site. However, a potential exposure pathway found during the RD but not considered in the ROD (inhalation, indoor air) was re-investigated in 2002-03, with results pending. While limited in scope, the earlier 1994 crawl-space air study indicates clearly that the likely range of detections, if present, would only have the potential to present long-term rather than short-term risks.

Besides the findings above, no other information has come to light that would call into question remedy protectiveness.

SECTION 7 Issues

Table 6 summarizes the issues which have been identified in the preceding sections of this Five Year Review Report.

Table 6. Five Year Review Issues

Issues	Affects Current Protectiveness	Affects Future Protectiveness
1. The contaminated groundwater plume needs to be defined along the eastern boundary in both the shallow and intermediate aquifers, to support modifying the PTS and achieving capture or treatment.	No	Yes
2. The PTS' vertical depth of capture needs to be verified through well measurements and/or sample evidence from groundwater entering Wards Creek. Additional verification that no escape is occurring under the creek should be obtained.	No	Yes
3. Capture along the North Line and South Line needs to be improved in order to achieve full capture and prevent contaminant escape into Wards Creek.	No	Yes
4. On the former Elmore property, the area surrounding sample location A6 may be highly contaminated enough to affect how the PTS is to be modified.	No	Yes
5. Crawl-space air sampling results (May 2003) are in review and could require that remedial actions be taken to mitigate risks.	No	Possible

SECTION 8 Recommendations and Follow-up Actions

To achieve long-term protectiveness, the issues listed above will require that a series of followup actions be implemented. The actions and planned milestones are summarized below.

Table 7. Followup Actions and Milestones

Issue	Recommendations and Followup Actions	Responsible Party	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
1, 2	An additional phase of characterization work should be completed to address Issues 1 and 2. (Characterization work may be iterative with any PTS modifications taken to address Issue 3 below). The focus of the work will be (a) verifying the eastern plume boundary, and (b) verifying the extent of contaminant escape into Wards Creek just to the north, and the lack of escape under and beyond the creek. If additional air sampling (crawl-space or indoor air) proves necessary, this must also be included.	EPA	6/30/2004 (Complete)	No	Yes
3	Implement physical modifications to the PTS to improve capture. Installation of additional pumping wells and monitoring wells is anticipated.	EPA	March 30, 2005 (Note 1)	No	Yes
4	On the former Elmore property, the area surrounding sample location A6 must be investigated and appropriate response actions taken.	EPA	06/30/2004 (Complete)	No	Yes
5	Crawl-space air sampling results (2003) must be presented to the public; and, any necessary remedial actions taken.		10/30/2003 (Reported); 06/30/04 (Actions complete)	No	Possible

Notes

1. This milestone represents completing as much modification work as possible. However, groundwater work usually requires that investigation and system modification tasks be done in iterative steps, rather than "all investigation complete" followed by "all modifications complete." Thus additional changes may be made after the milestone date.

SECTION 9 Protectiveness Statement

The remedy at the Elmore Waste Disposal Site is currently protects human health and the environment because the PTS is capturing a significant portion of the contaminated groundwater moving offsite; current data indicate contamination is entering the creek at the Site boundary and not escaping under it; there is no current exposure; and adequate notice to the public is being maintained to prevent exposure. However, in order for the remedy to be protective in the long-term, the actions listed in Section 8 above need to be taken. The actions include:
(1) conducting an additional phase of characterization work to address issues of plume delineation and escape, work which may have to be iterative with any PTS modifications undertaken;
(2) implementing physical modifications to the PTS to improve capture;
(3) investigating the area surrounding sample location A6 on the former Elmore property, and taking appropriate response actions; and
(4) reporting the 2003 crawl-space air sampling results to the public, and completing any necessary remedial actions.

SECTION 10 Next Review

Because the Site remedy will continue for more than five years, and contaminated groundwater remains at the Site, a second Five Year Review will be completed five (5) years from the date of this report, which will be September 23, 2008.

Appendix 1
Site Proposed Plan Fact Sheet (1993)

U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV, ATLANTA, GA
DECEMBER 1992

SUPERFUND FACT SHEET

Superfund Proposed Plan
ELMORE WASTE DISPOSAL SUPERFUND SITE
Greer, Spartanburg County, South Carolina

INTRODUCTION

The United States Environmental Protection Agency, Region IV (EPA) has prepared this Fact Sheet to propose a cleanup plan to address soil and groundwater contamination at the Elmore Waste Disposal Superfund Site (the Site) in Greer, Spartanburg County, South Carolina. EPA is the lead Agency for remedial activities at the Site and has investigated the Site in cooperation with the South Carolina Department of Health and Environmental Control (SCDHEC). Words appearing in ***bold*** print are defined in the glossary that begins on page 22.

THIS PROPOSED PLAN:

1. *Includes a summary of site background and the findings of the* ***Remedial Investigation (RI)****;*
2. *Describes the remedial alternatives for site cleanup considered in the* ***Feasibility Study (FS)****;*
3. *Presents EPA's preferred alternative and the reasons for the preference;*
4. *Solicits public review and comment on all remedial alternatives; and*
5. *Provides information on how the public can be involved in the remedy selection process.*

ELMORE WASTE DISPOSAL SITE PROPOSED PLAN PUBLIC MEETING
THURSDAY, JANUARY 14, 1993, 7:00 P.M.
GREER HIGH SCHOOL
AUDITORIUM
505 NORTH MAIN STREET, GREER, SOUTH CAROLINA

You are encouraged to attend the public meeting to learn more about the cleanup alternatives developed for the Site, as well as the alternatives proposed by EPA. The public meeting will also provide an opportunity for interested individuals to submit comments to EPA on the Feasibility Study and Proposed Plan.

The selection of a cleanup plan, or "preferred alternative," represents a preliminary decision by EPA, subject to a public comment period. A final decision will be made by the Agency only after all public comments have been reviewed and considered.

As outlined in section 117(a) of the the ***Comprehensive Environmental Response, Compensation, and Liability Act of 1980*** (also known as "Superfund"), as amended by the ***Superfund Amendments and Reauthorization Act of 1986*** (also known as "SARA"), EPA encourages public participation by publishing Proposed Plans for addressing contamination at Superfund sites, and by providing an opportunity for the public to comment on the proposed remedial actions. As a result of such comments, EPA may modify or change its preferred alternatives before issuing a ***Record of Decision*** for the Site. Further information concerning opportunities for public participation is found on page 20.

SCOPE AND ROLE OF THE PROPOSED ACTION:

The principal threat posed by the Site is an area of contaminated soils located in one portion of the Site. Contamination in this area could cause health effects directly through long-term exposure or indirectly by leaching into shallow groundwater that could be used as a potable water source.

EPA's plan for remediation of the Elmore Site will address all threats posed by the Site: contaminated soil onsite, groundwater contamination on and offsite, and contaminated surface water offsite (Wards Creek). EPA's preferred alternative for cleanup of Site soils is Alternative SS6: Offsite Disposal. Alternative GW5B: Groundwater Extraction, Metals Reduction, Air/Gas/Steam Stripping, POTW Discharge is the preferred alternative for remediation of groundwater. Each of these alternatives provides the best balance of trade-offs among the criteria EPA uses to evaluate remedial alternatives. SCDHEC has reviewed the preferred alternative and concurs with EPA's selection. The preferred alternative for each medium (soil, groundwater) and the others considered are summarized in this fact sheet and presented more fully in the Feasibility Study (FS).

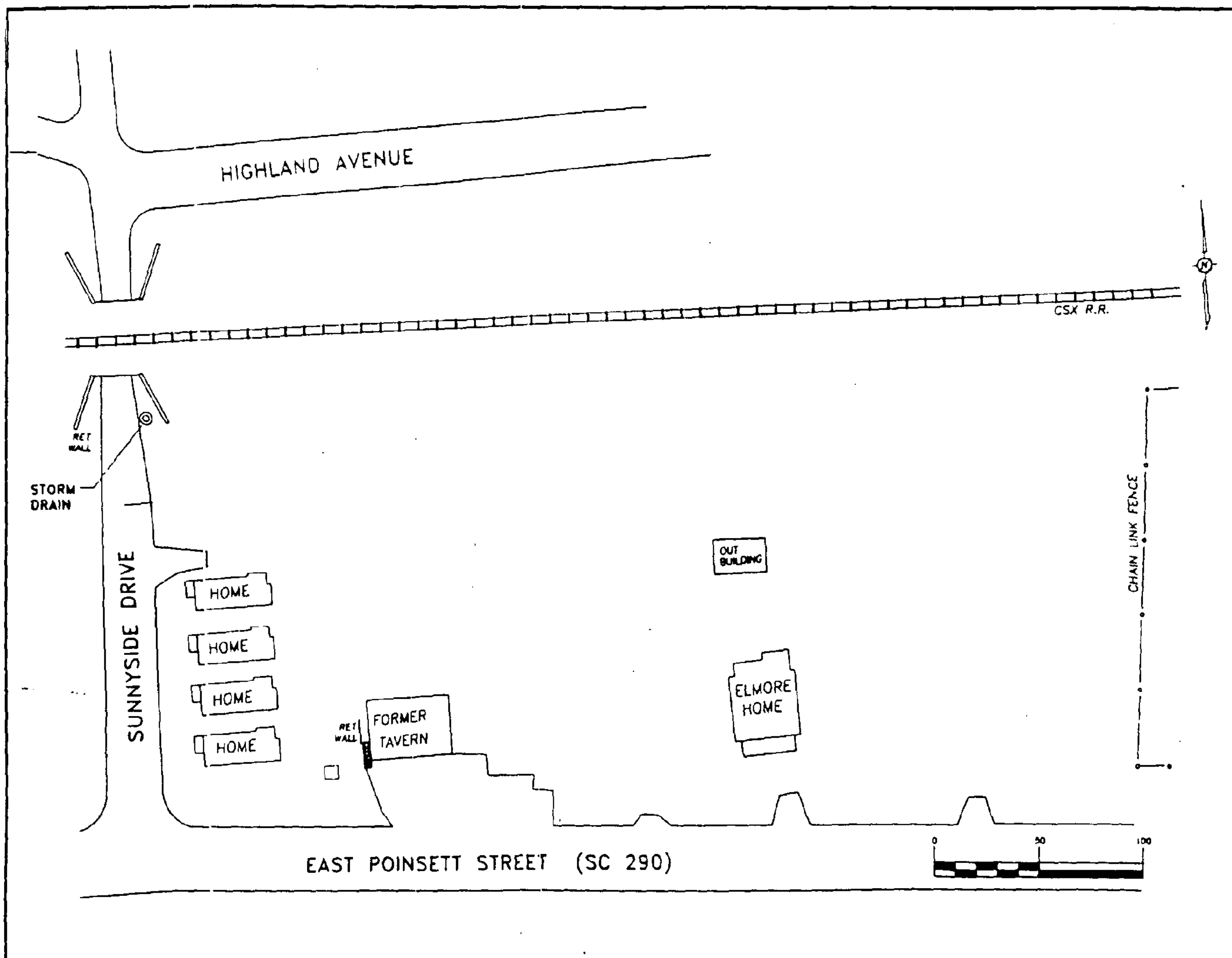
SITE BACKGROUND

Description. The Site, a grassy field approximately 1/2-acre in size, is located along East Poinsett Street in Greer, South Carolina (Figure 1). The surrounding area is mainly residential, with some light industry. All homes in the area are connected to the city water supply system; no water wells are known to exist within 1 mile of the Site. The Site is bordered on the north by property and railroad tracks owned by CSX Transportation, Inc., on the south by Poinsett Street and an abandoned former tavern, to the east by one residence, and to the west by four single family homes.

Site History. Between 1975 and 1977, Mr. R. L. Elmore took in numerous drums containing various liquid and solid wastes. Contaminated waste oil was also stored onsite in an open-top, bulk storage tank. In response to odor complaints from neighboring residents in 1977, the SCDHEC conducted an inspection of the Elmore Site. SCDHEC personnel discovered a number of drums onsite, some of which were leaking. The Site's owner, Mr. R. L. Elmore, then entered into a Consent Order with the State of South Carolina for the cleanup of the Site and proper disposal of the waste materials. Later in 1977, a few of the drums were removed to an undisclosed location(s), and piles of wood chips were placed in areas where drum leakage occurred.

In early 1980, SCDHEC attempted to establish a new agreement for cleanup activities. R. L. Elmore had fallen ill and SCDHEC had been referred to Frank Elmore, one of R. L. Elmore's sons, who was said to be responsible for the Site. However, Frank Elmore could not be located. Later in 1980, EPA personnel inspected the Site and found a partially buried, 6,000-gallon storage tank containing what appeared to be waste oil, and approximately 100 unmarked, leaking drums in various stages of decay.

FIGURE 1



ELMORE WASTE DISPOSAL SUPERFUND SITE

Between August 1981 and January 1982, an EPA contractor investigated Site conditions. At that time, twenty-five 55-gallon drums remained on site, all containing soil and/or wood chips. A soil sample taken from the northwest portion of the Site, in the path of the storm water runoff, revealed the presence of elevated concentrations of ***Inorganic contaminants*** including chromium, copper, lead, zinc and cyanide. Twenty-two ***organic compounds*** were also detected; however, the contractor's report noted that some of the contaminants could possibly be attributed to wood preserving chemicals used on railroad timbers of the adjacent Piedmont and Northern Railroad (now CSX Railroad).

In early 1983, SCDHEC again inspected the Site and found 250 to 300 drums in various stages of decay scattered over the Site. After further soil sampling in 1984, EPA coordinated preparation of a Hazard Ranking System (HRS) package in January 1986. In the summer of 1986, under the direction of SCDHEC, GSX Services Inc. (GSX) conducted a removal action at the Elmore Site. This action included the excavation, transportation and disposal of 5,477 tons (approximately 5,000 cubic yards) of contaminated soil and 16,840 pounds of liquids. The solids were landfilled at GSX's chemically secure landfill in Pinewood, South Carolina, and the liquids were incinerated at Thermal Oxidation Corporation in Roebuck, South Carolina. The onsite excavation was backfilled with 5,456 cubic yards of clean fill dirt. The total cost was $927,207.91. In order to monitor groundwater, four monitoring wells were installed onsite after the removal operation was completed. Samples from these wells in 1986 and 1987 revealed groundwater contamination onsite.

In June 1988, the Elmore Site was proposed for addition to the ***National Priorities List (NPL)*** and was added to the NPL on March 30, 1990. In May 1989, EPA sent Potentially Responsible Party (PRP) Notification letters to Elmore family members and those who were believed to be knowledgeable of the Elmore Site. Based on the information received in response to these letters, EPA elected to perform the RI/FS using public funds under CERCLA.

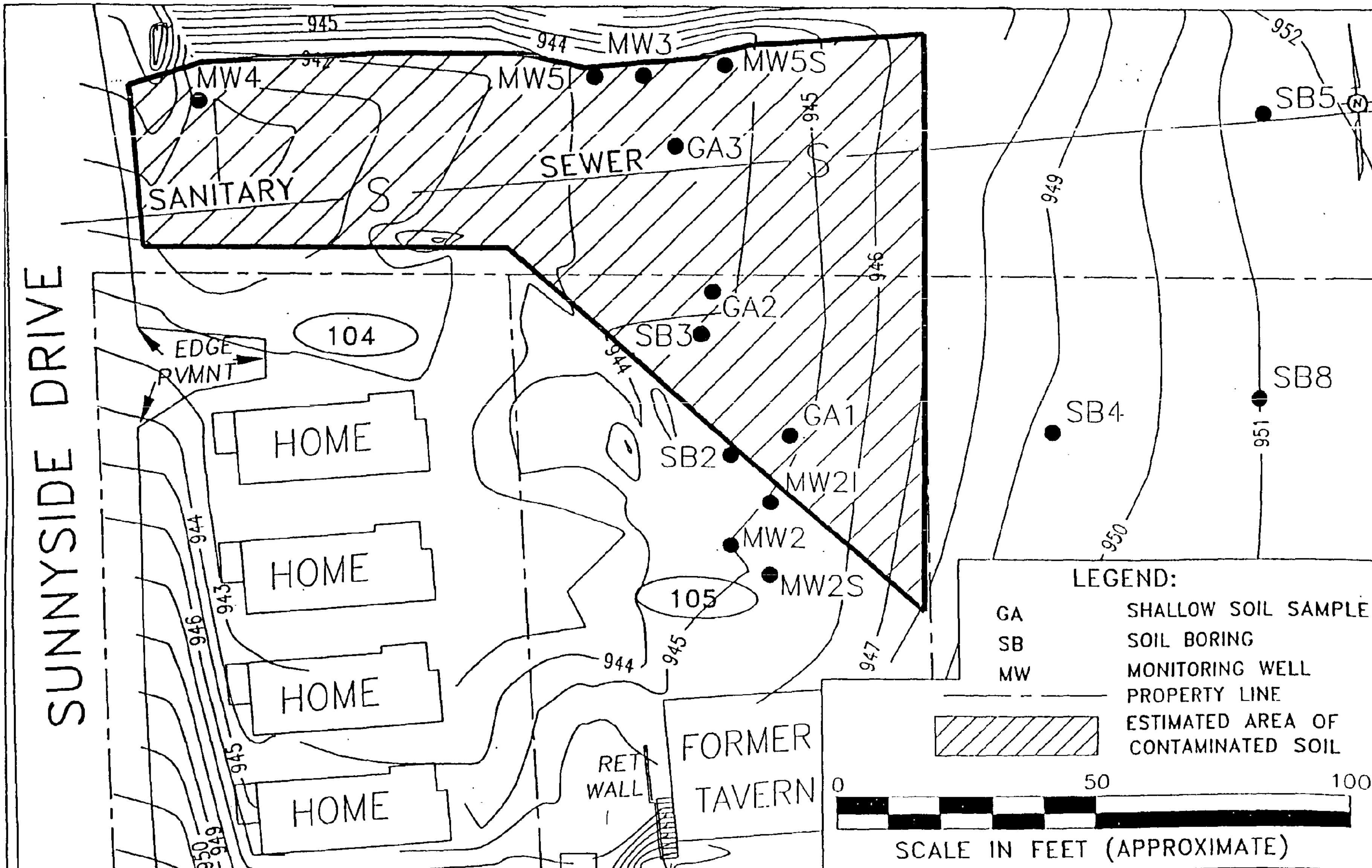
Planning of the RI/FS took place in late 1989 and early 1990. A public meeting concerning the start of the RI/FS was held at the Greer City Hall on March 22, 1990. However, the start of field work was delayed because two of the Site landowners refused to grant EPA access to do the study. Access agreements were obtained in February 1991, and RI/FS field work began on March 12, 1991. On-site field work ended in late June 1991. Off-site groundwater sampling events were conducted in January, April and May 1992.

RESULTS OF THE REMEDIAL INVESTIGATION

The RI investigated the nature and extent of contamination on and near the Site and defined the potential risks to human health and the environment posed by the Site. A total of 37 soil, 27 groundwater, and 8 surface water samples were collected. More detailed information can be found in the RI and FS reports and the ***Baseline Risk Assessment***, These documents are available to the public (page 21).

Soil Contamination. Surface soil contamination is limited to an area along the western edge of the Site (Figure 1). Inorganic contaminants (metals), including arsenic, cadmium, chromium, lead, nickel, and zinc, are present at levels significantly above background. The principal contaminant of concern is lead, which was present at levels almost four times EPA's level of concern (500 ***mg/kg***). Trace levels of organic compounds (mainly ***PAHs*** and dioxin) are present, but at levels that are so low they 1) do not pose a health risk and 2) will not migrate or leach from the soil into groundwater. One sample of deeper soil had higher levels of three organic compounds, but the levels are not sufficient to pose a threat to groundwater. There are no EPA-established standards for contaminant levels in soil.

Groundwater Contamination. Groundwater in the shallow (surface) aquifer is contaminated by both inorganic contaminants and volatile organic compounds (VOCs). Levels of individual VOCs ranged from the detection limit (normally 0.005 mg/l) to 1.4 mg/l onsite and up to 12 mg/l offsite just across Highland Avenue to the north. Seven of the inorganic and seven of the VOC concentrations violate the ***Maximum Contaminant Levels (MCLs)*** for those substances. The intermediate-depth aquifer, extending to a depth of approximately 55 feet, shows contamination by several organic and inorganic compounds. Bedrock wells contained 3 organic compounds at estimated values that are below the detection limit and below MCLs.



ESTIMATED AREA OF CONTAMINATED SOIL ABOVE REMEDIAL GOALS

ELMORE WASTE DISPOSAL SUPERFUND SITE

FIGURE 2

Groundwater flow is north-northwest. Contamination extends northward to Wards Creek, which is located 700 to 1100 feet north of the Site. Figure 1 shows the approximate extent of contamination of the surface aquifer. The offsite samples were collected only from the surface aquifer because onsite samples from it showed much more contamination than samples from the intermediate aquifer, and because monitor well elevation data indicated that groundwater moves much faster in the surface aquifer than in the intermediate aquifer.

Surface Water Contamination. Samples from Wards Creek contained low levels of two ***volatile organic compounds (VOCs)***, trichloroethene (TCE) and tetrachloroethene (PCE), at 0.085 and 0.016 mg/l, respectively. Two other VOCs were present at less than 0.003 mg/l. The trichloroethene value is above South Carolina Ambient Water Quality Standards for surface waters, which for TCE is 0.005 mg/l. Despite the presence of a former dump area along and south of the creek, no other types of contaminants were detected in Wards Creek. Samples from a groundwater seep near the creek and from from a drainage ditch that runs north along Sunnyside Drive suggest that the surface aquifer is discharging contaminated groundwater into the creek. The two VOCs listed above are found in onsite and offsite wells and can be attributed to the Elmore Site.

BASELINE RISK ASSESSMENT

The Baseline Risk Assessment describes the risks to human health and the environment that would result if the contamination present at the Elmore Site is not cleaned up. To quantify the risk to human health, the assessment proceeds in a series of steps. First, a list is generated of all the chemicals present and their concentrations. Next, the Assessment considers the present and future population living on the Site. In this case, adults and children living onsite (residents), plus visitors to the Site (nonresidents). Then, from the present use of the Site and likely future use scenarios, "pathways" through which persons could be exposed to the contaminants are developed. Pathways at the Elmore Site include dermal (skin) contact with contaminated soil, ingestion of contaminated soil, inhalation of vapors from showering with contaminated groundwater, and others.

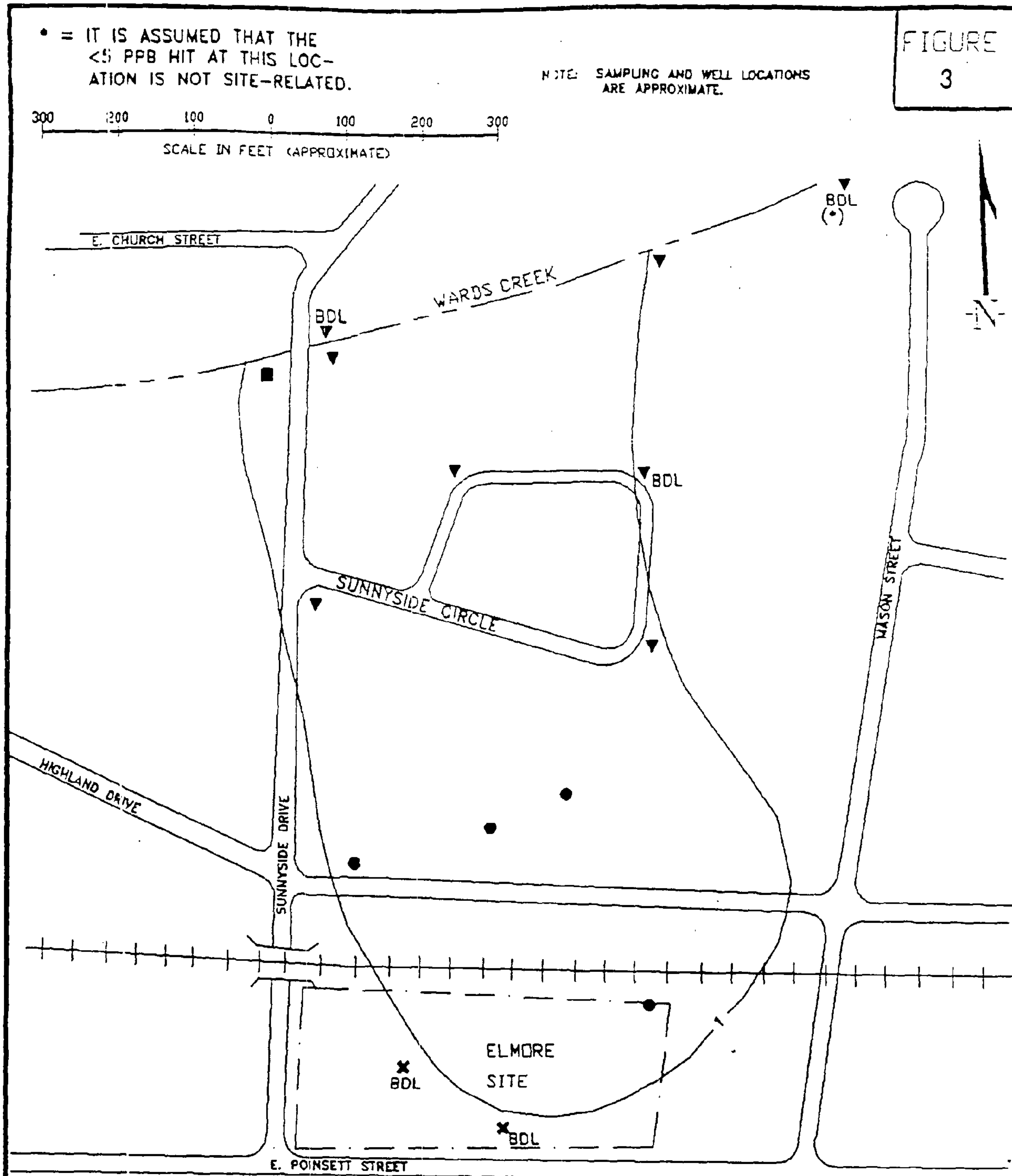
Using scientific data on the toxic characteristics of each contaminant, the pathways of exposure can be developed by making assumptions such as the length and number of times exposed, how much of the chemical is ingested, and certain other factors. A calculation can be made using known effects and reasonable exposure assumptions. For each pathway, two calculations are made to account for the two general types of contaminants: ***carcinogens***, suspected or known to cause cancer, and ***noncarcinogens***, substances that are hazardous and cause damage to human health through other effects.

For carcinogens, the result is expressed as the excess cancer risk posed by Site contaminants. EPA has established a range of 1×10^{-4} to 1×10^{-6} as acceptable limits for lifetime excess carcinogenic risks. Excess risk in this range means that one person in 10,000 (1×10^{-4}) to one person in one million (1×10^{-6}) will risk developing cancer after a lifetime of exposure. For each pathway, the cancer risk from each individual contaminant is added together, because in a "worst case" scenario a person could be exposed through several or all possible pathways.

Noncarcinogenic risk is expressed as a Hazard Index. The Hazard Index (HI) is the ratio of the amount of the chemical taken in, divided by the reference dose, an intake amount below which no adverse effects are known to occur. As with cancer risk, for each pathway, the HIs for the individual contaminants are added together.

Carcinogenic risk and noncarcinogenic HIs were calculated for both the current land use scenario, with residents on and near the Site, and the anticipated future use scenario, which is continued residential use. For residents nearest the Site, the current situation at the Elmore Site has a carcinogenic risk of 1.9×10^{-4} and a future use risk of 1.7×10^{-2}. Both values are above the acceptable limit of 1×10^{-4}. For noncarcinogenic risk, the present use HI is 0.2, while the future use HI is 16.0, which is above EPA benchmark of 1.0. The most serious pathways and risks at the Site are:

Present use:
- Child - ingestion of surface soil
  (carcinogenic and noncarcinogenic)



LEGEND

- ● ESD TEMP MONITORING WELL
- ▼ GEOPROBE SAMPLE LOCATION
- BDL BELOW DETECTION LIMIT
- ■ HAND AUGERED BORING GROUNDWATER SAMPLING LOCATION
- ✖ BVWST PERMANENT SHALLOW WELL (1991 RI DATA)

MAP OF TOTAL VOLATILE ORGANIC CONCENTRATIONS
FOUND IN SHALLOW GROUNDWATER (ug/L)
ELMORE WASTE DISPOSAL SUPERFUND SITE
GREER, SOUTH CAROLINA

FIGURE
3

Future use:

- Adult or child - ingestion of groundwater (carcinogenic and noncarcinogenic)
- Child - ingestion of surface soil (carcinogenic and noncarcinogenic)

Because of the residential nature of the Site and surrounding area, the Site presents little or no risk to the environment, except at Wards Creek. In view of the presence of VOCs in Creek water, reducing the environmental risk to this area will require that the Site remedy reduce the levels of contamination in the shallow aquifer, which contributes contamination to the Creek.

More detailed information concerning Site risks is presented in the Baseline Risk Assessment, which is available at the public information repository described on page 21.

REMEDIAL OBJECTIVES AND ALTERNATIVES

Remedial Action Objectives

Based on the RI and Baseline Risk Assessment, EPA has established the following remedial action objectives for the Elmore Waste Disposal Site:

- Prevent ingestion of groundwater containing any carcinogen concentrations above Federal or State limits, or if there is no established limit, above levels that would allow a remaining excess cancer risk of greater than 10^{-6} to 10^{-4}.
- Prevent ingestion of water containing any noncarcinogen concentrations above Federal or State limits, or if there is no established limit, above levels that would allow an unacceptable remaining noncarcinogenic threat (HI greater than 1.0).
- Restore the groundwater system to potential productive use by cleanup to the standards described above and by preventing the migration of the pollutants beyond the existing limits of the contaminant plume.
- Prevent ingestion or direct contact with contaminated soil having greater than a 10^{-6} to 10^{-4} excess cancer risk or exceeding the allowable health threat (HI greater than 1.0) for noncarcinogens.
- Prevent migration of contaminants from the soil to groundwater, which would result in groundwater contamination in excess of Federal/State limits or health-based maximum levels.
- Reduce or eliminate concentrations of contaminants in Wards Creek, and maintain water quality in accordance with the applicable Federal and State of South Carolina Ambient Water Quality Criteria for surface waters.

Establishment of Remediation Goals

EPA has established specific remediation goals (cleanup standards) for certain soil, groundwater, and surface contaminants. Such standards are established under several Federal environmental laws, including the Safe Drinking Water Act (for water systems and potable water sources such as groundwater) and the Clean Water Act (for surface waters). South Carolina has similar statutes. Some contaminants regulated under these standards are present at the Site. In cases where there is no State or Federal standard, remediation goals were developed in the FS based on human health risk assessment calculations or the contaminant's leachability potential. Table 1 summarizes remediation goals for groundwater, and Table 2 summarizes remediation goals for soils at the Elmore Site.

TABLE 1
GROUNDWATER REMEDIATION GOALS

Contaminant	Maximum Concentration Detected (ug/l)	Remediation Goal (ug/l)	Source
Volatile Organic Compounds			
Benzene	48	5	A
Carbon Tetrachloride	2	5	A
Cis-1,2-Dichloroethene	140	7	A
1,2-Dichloroethene	41	7	A
Methylene Chloride	32	5	B
Tetrachloroethylene	4,000	5	A
Trichloroethylene	12,000	5	A
1,1,1-Trichloroethane	310	200	A
1,1,2-Trichloroethane	2	5	A
Vinyl Chloride	69	2	A
Inorganic Contaminants			
Beryllium	51	1	A
Cadmium	6	5	A
Lead	270	15	C
Manganese	9100	3000	D
Chromium	300	100	A
Nickel	230	100	A
Vanadium	810	200	D

SOURCES OF REMEDIATION GOALS:

A - MCL
B - Proposed State of South Carolina MCL
C - EPA Action Level
D - Health-Based Remediation Goal (HI > 1.0)

TABLE 2 SOIL REMEDIATION GOALS			
Contaminant	Maximum Concentration Detected (Mg/kg)	Remediation Goal (Mg/kg)	Source
<u>Inorganic Contaminants</u>			
Surface Contact (0-2 ft.):			
Arsenic	37	10	A
Beryllium	4.1	4.0	A
Lead	1900	500	B
Subsurface (Leaching):			
Arsenic	37	300	C
Beryllium	4.1	9	C
Cadmium	2.3	4	C
Chromium	81	800	C
Nickel	39	400	C
Manganese	870	10000	C
Vanadium	140	600	C

SOURCES OF REMEDIATION GOALS
A - Health-Based Remediation Goal
B - EPA Health-Based Level of Concern
C - Leachability-Based Remediation Goal

Development of Remedial Alternatives

In the Feasibility Study, remedial alternatives were constructed and evaluated for soil contamination and groundwater contamination. Alternatives were not developed to address surface water for the following reasons:

1) The RI data suggest that the VOCs entering Wards Creek originate in the contaminated surface aquifer, which discharges to the creek in the area along the south side of the creek; through the Sunnyside Drive drainage ditch; and possibly elsewhere within the area of groundwater contamination.

2) It is anticipated that by capturing and treating groundwater in the area of contamination ("the plume"), discharge to the creek will be greatly reduced and concentrations in the creek will drop to levels below Ambient Water Quality Criteria or detection limits.

To formulate the alternatives for cleanup, all possible technologies, processes and methods that could be utilized in a cleanup effort were evaluated, and those that could not be used at the Elmore Site were screened out. The screening criteria employed are primarily site-specific factors that make some technologies or processes ineffective, difficult to implement, or infeasible. Such factors include soil type, geology/hydrogeology, site location, and the area or volume of contaminated media. Technologies and processes considered to be potentially useful were then grouped together into remedial alternatives to address soil contamination and groundwater contamination. Then, the alternatives were evaluated and compared against one another in detail.

EVALUATION OF REMEDIAL ALTERNATIVES

EPA uses the following criteria to evaluate the alternatives developed in the FS and to select its preferred alternative. . Seven of the criteria, based on environmental protection, cost and engineering feasibility issues are used to evaluate all the alternative. The preferred alternative is further evaluated based on the final two criteria, State and Community acceptance.

Threshold Criteria: These two statutory requirements must be met by all alternatives.

1. *Overall Protection of Human Health and the Environment* addresses the degree to which an alternative meets the requirement that it be protective of human health and the environment. This includes an assessment of how public health and environmental risks are properly eliminated, reduced or controlled through treatment, engineering controls, or controls placed on the property to restrict access and (future) development.

2. *Compliance with **Applicable or Relevant and Appropriate Requirements (ARARs)*** addresses whether an alternative complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup options at a specific site. If an ARAR cannot be met, the analysis of the alternative must provide the grounds for invoking a statutory waiver.

Primary Balancing Criteria: These five considerations are used to develop the decision as to which alternative should be selected.

3. *Long-Term Effectiveness and Permanence* refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the cleanup goals have been met.

4. *Reduction of Toxicity, Mobility, and Volume* addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substance as their principal element.

5. *Short-Term **Effectiveness*** addresses the impacts of the alternative on human health and the environment during the construction and implementation phase, until remedial action objectives have been met.

6. *Implementability* refers to the technical and administrative feasibility of implementing an alternative, including the availability of various services and materials required for its implementation.

7. *Cost* consists of the capital (up-front) costs of implementing an alternative, plus the costs to operate and maintain the alternative over the long term. Cost for each alternative is given as the net present worth of both the capital costs and the operation and maintenance (O&M) costs.

Modifying Criteria: These two considerations indicate the acceptability of the alternative to the public, local or State officials.

8. *State Acceptance* addresses whether, based on its review of the RI, FS, and Proposed Plan, the State concurs with, opposes, or has no comments on the alternative once it is proposed by EPA as the selected alternative (called the remedy).

9. *Community Acceptance* addresses whether the public agrees with EPA's selection of the alternative. Community acceptance of this Proposed Plan will be evaluated based on comments received during the upcoming public meeting and public comment period.

SUMMARY OF THE REMEDIAL ALTERNATIVES

The cost given for each alternative is the total present worth (PW) of capital costs (initial investment) plus operation and maintenance (O&M) costs, using a five percent discount rate per year. Implementation denotes the estimated amount of time it will take to complete the cleanup action, once it has begun. More detailed descriptions of the alternatives, and descriptions of the strengths and weaknesses of each alternative in terms of EPA's nine standard criteria, can be found in the FS.

Alternatives for Remediation of Soils

Five alternatives to address soil contamination were developed and compared in the FS. All alternatives are subject to the following assumptions and requirements:

- The area of contaminated soil is defined as shown in Figure 2. In the Remedial Design (RD) phase, additional sampling will be conducted to precisely define the southwestern edge of the area.
- ***Bench scale*** and/or ***pilot scale treatability studies*** may be required for the selected soil alternative to confirm the effectiveness of the alternative.
- Confirmation sampling and analysis will be required during implementation of the selected soil alternative to assure that it achieves the remedial action objectives and the soil remediation goals identified in Table 1.

ALTERNATIVE SS1 - NO ACTION

CERCLA requires that EPA evaluate a "No Action" to serve as a basis against which other alternatives can be compared. Under this alternative, no actions are taken nor are funds expended for control or cleanup of contamination associated with the contaminated soil. Because contaminants would be left onsite under this alternative, a review is required every five years in accordance with the requirements of CERCLA. This constitutes the only cost involved and is considered an O&M cost.

Under this alternative, Site conditions would remain unchanged. Contaminated soil at the surface would continue to present an unacceptable health risk now and in the future.

Implementation: N/A
Total PW Cost: $41,700

ALTERNATIVE SS2 - SOIL/SYNTHETIC MEMBRANE CAP

This alternative would include the construction of a soil-synthetic membrane cap over the contaminated area, revegetation, and surface drainage controls. In addition, this alternative would include the use of institutional controls to prevent direct contact and incidental ingestion of contaminated soil by the general public. To reduce the opportunity for exposure, a 6-foot security fence would be installed around the contaminated area and warning signs would be displayed on the fences to alert the public of potential hazards. Future uses of the property would be limited by applying deed restrictions. State and local agencies would be responsible for the implementation and enforcement of these restrictions. Air, soil and surface water monitoring would also be continued onsite.

The soil-membrane cap would consist of the synthetic liner installed over the contaminated soil area, a drainage layer, and a ***geotextile fabric*** liner placed over the drainage layer. The geotextile fabric would be covered by a 2-foot soil and topsoil cover. The soil and drainage layers protect the liner layer from heat and other environmental effects. The topsoil layer of the cap would be graded to a gentle slope designed to match current site topography. Some grading of the contaminated soil may be required to achieve such slopes. A vegetative cover of native grass would be established to minimize cap erosion. Surface drainage channels would be constructed around the perimeter of the cap to collect surface runoff and water from the drainage layer. The collected water would be discharged to an offsite storm water collection point.

Since the contaminated soils would not be treated, judging this alternative's effectiveness would include monitoring Site groundwater. Therefore, the alternative includes periodic groundwater monitoring for an assumed period of 30 years. Periodic maintenance of the soil-membrane cap and surface drainage systems would also be required during an assumed 30-year period.

Implementation: 5 months, 30 years O&M
PW Cost: $208,800

ALTERNATIVE SS3 - SOIL STABILIZATION

Soil Stabilization is a process involving the addition of Portland cement, chemical binders, and water to the excavated contaminated soil. The soils and binders are then thoroughly mixed with machines typically used for concrete mixing, or they could be mixed in place with backhoe equipment. After mixing, the soils would be backfilled into the original excavation and allowed to cure and harden. The curing reaction produces a dense, strong, low-permeability block, called a "***monolith.***" The monolith would then be covered with one foot of clean native soil and the treated area graded to provide adequate drainage. The grading is necessary because the process increases the volume of treated soil. A vegetative stand would be established over the treated area.

In addition to stabilizing the soils, site access would be restricted by fencing selected areas. Water would be used to minimize dust emissions during soil excavation, transport, and handling. Stockpiled soils and debris would be covered with tarps or plastic sheeting to minimize dust emissions and runoff. During the curing process, heat generation caused by chemical reactions may cause VOC emissions to the air. Therefore, the entire curing area would be covered with plastic sheeting, and a ventilating and carbon adsorption system would be utilized to capture emissions. The initial excavation of contaminated soil would include all soil containing contamination greater than the levels specified a remediation goals. Treated soils will be considered to meet remedial action objectives if they do not leach to groundwater, as determined by the Toxicity Characteristic Leachate Procedure (TCLP). However, a more appropriate standard may be developed in the Remedial Design phase. Surface water runoff, VOC emissions, and treated soils would be monitored to ensure that the remedial action objectives were being met.

Implementation: 9 - 12 months, 30 years O&M
PW Cost: $242,400

ALTERNATIVE SS4 - SOIL WASHING, STABILIZATION, AND OFFSITE DISPOSAL

Alternative SS4 involves excavating the contaminated soils, screening and separating large debris, soil washing the contaminated soil, stabilizing the remaining highly-contaminated soil fraction, and transporting the stabilized soils to a RCRA solid waste landfill. After soil washing, the treated soil (approximately 90 percent of the original volume) would be backfilled onsite after testing to verify that remediation goals have been met.

Soil washing involves placing screened and sized contaminated soils into a high energy contacting and mixing vessel where the soils are scrubbed with a washing fluid. The sand and coarser material in the soil usually requires only this primary washing step; the more highly contaminated clay and silt fractions are hydraulically separated and sent to a special counter-current washer module for more intensive washing. The more aggressive washing in this stage removes the highly adsorbed contaminants. After this step, all particles larger than a certain size (0.074 cm) are rinsed, dewatered, and combined with the coarse material from the initial washing step to be stockpiled, tested against the remediation goals, and eventually backfilled. The remaining fine particles are then dewatered and removed. Depending on the specific soil, this remaining highly-contaminated fraction is generally 10 to 15 percent of the initial volume of contaminated soils. These solids would be tested for leachability (TCLP) and then transported to a RCRA hazardous or non-hazardous solid waste landfill according to the results.

Prior to being washed, the contaminated soil would be excavated and would undergo solids separation and sizing. Techniques could include screens, shredders, and grinders for removal of large stones and debris so that they can be appropriately treated. Such debris could be washed in a separate mixer or decontaminated by high-pressure steam washing.

In addition to the activities described above, site access would be restricted by fencing selected areas until remedial activities were completed. Material handling procedures would be the same as for Alternative SS3; that is, use of soil moisture to minimize dust emissions during soil excavation, transport, and handling; and tarps or plastic sheeting over stockpiled soil to minimize dust emissions and runoff. Both soil washing and stabilization could potentially generate VOC emissions, so that systems for emissions capture and treatment would be necessary. Surface water runoff and treated debris would also be monitored to ensure that the remedial action objectives were being met. After treatment activities have ended, clean native fill material would be placed in the excavation. The entire site would then be graded to provide proper drainage, and a natural vegetation stand would be established to minimize erosion.

PW Cost: $254,900
Implementation: 9 - 12 months, 30-years O&M

ALTERNATIVE SS5 - IN-SITU VITRIFICATION

In-Situ Vitrification (IVS) is a process whereby contaminated soils are melted in place, binding the contaminants in a glassy, solid matrix. Melting is produced by a high-voltage electric current passed between electrodes placed into the soil. Melt temperatures in the range of 1600º C to 20000º C causes organic substances in the soil to break apart and migrate to the surface, where they combust with atmospheric oxygen. The gases produced would be trapped by a hood over the treatment area that directs them through an air emissions treatment system. Inorganic contaminants remain trapped within the glass matrix formed by the melt. The solid mass created after the melt cools is resistant to leaching and more durable than concrete.

Environmental monitoring encompassing air, soil and surface water runoff will be performed if there is further offsite migration of soil contaminants. The vitrification process would cause a 10 to 20 percent reduction in the soil volume being treated. Limited backfilling of clean soil to fill this void and regrading to support revegetation will be required to prevent erosion and reduce infiltration. Since this alternative involves a monolith, similar to that described in Alternatives SS3 and SS4, verifying that this alternative meets the remedial action objectives will involve leachability testing against TCLP or a more appropriate standard if one is developed in the Remedial Design.

In-situ vitrification is an innovative technology that has been proven effective in treating both organically contaminated and inorganically contaminated soil. Operational scale units are available but have not yet been utilized on a full scale basis at a Superfund site. Therefore, before full scale implementation of ISV, samples would be collected for bench scale treatability studies to verify that the technology will achieve the remedial action objectives.

PW Cost: $816,500
Implementation: 9 - 12 months, 30 years O&M

ALTERNATIVE SS6 - OFFSITE DISPOSAL

Alternative SS6 consists of the excavation of all contaminated soil, followed by final disposal (and treatment if required) at a regulated **RCRA** solid waste landfill.

Comparison of the cleanup standards in Table 1 with the RI soil sampling results indicates that only the top two feet of soil in the area of contamination will require removal. This will be verified by further sampling at the time of excavation. Soil in the affected area will be excavated and transported to a RCRA solid waste landfill. Following excavation, clean native fill material would be placed in the excavation. The entire site would then be graded to provide proper drainage, and a natural vegetation stand would be established to minimize erosion.

Soil samples from the RI borehole cuttings were tested using the Toxicity Characteristic Leachate Procedure (TCLP). Test results suggest there are no hazardous wastes, as defined by RCRA, remaining onsite. However, certain of the more highly contaminated soils may test as hazardous by TCLP. Therefore, under this alternative it is assumed that the soils are hazardous and thus will require treatment at the RCRA hazardous waste landfill facility before disposal. Typically, the treatment used for metals-contaminated soils is stabilization. If none of the soils are hazardous, they will be disposed of at a RCRA non-hazardous landfill.

In addition to the activities described above, site access would be restricted by fencing selected areas until remedial activities were completed. Material handling procedures would be the same as for Alternative SS3; that is, use of soil moisture to minimize dust emissions during soil excavation, transport, and handling; and tarps or plastic sheeting over stockpiled soil to minimize dust emissions and runoff.

PW Cost: $305,800
Implementation: 3 to 4 months

Alternatives for Remediation of Groundwater

Five alternatives were developed to address groundwater contamination. Certain groundwater alternatives include choices for specific options so that, for example, Alternative 3A and 3B may differ only in the use of one specific option. The components of Alternative GW2, institutional controls and groundwater monitoring, are implied for all alternatives except GW1, the "no action" alternative.

For each alternative, remedial action objectives will be considered met when concentrations listed in Table 1 are not exceeded in any on or offsite wells, and regular sampling confirms that contaminant levels in Wards Creek remain below applicable Federal and State limits.

All groundwater remediation alternatives include the following assumptions and requirements to be addressed in Remedial Design:

- In the early portion of the remedial design phase, additional groundwater sampling will be required to confirm the extent of shallow aquifer contamination offsite, particularly along the assumed western plume edge, and to the east-northeast of the Site. In this latter area, the presence or absence of another contributing source will be determined.

- The vertical extent of groundwater contamination will be further defined by sampling from the intermediate and deep aquifers offsite.

- At the start of the design phase, EPA or the PRP will initiate periodic groundwater monitoring of the Site and the affected area to the north, including surface water sampling of Wards Creek.

Alternative GW1 - No Action

Under the no action alternative, the Site is left "as is" and no funds are expended for monitoring, control, or cleanup of the contaminated groundwater. This alternative serves as a baseline for comparison with other alternatives.

If no action is taken, risks to persons living on and near the Site will remain. Also, contaminants will continue to discharge from the shallow aquifer to Wards Creek at levels that may exceed State or Federal environmental standards. Because hazardous contaminants would remain onsite, a five year review would be required under CERCLA. The cost for such a review is noted below.

PW Cost: $41,700
Implementation: N/A

ALTERNATIVE GW2 - GROUNDWATER USE RESTRICTIONS AND MONITORING

Under this alternative, institutional controls would be implemented to restrict the withdrawal and use of groundwater from the contaminated plume. A second component of this alternative would be monitoring of Site groundwater conditions.

The institutional controls to be used are deed restrictions and well permit restrictions. Deed restrictions prevent future use of the aquifer for such purposes as potable and industrial water supplies, irrigation, and washing. Permit restrictions issued by the State of South Carolina would restrict all well drilling permits issued for new wells on properties that may draw water from the contaminated groundwater plume. These restrictions could be written into the property deeds to inform future property owners of the possibility of contaminated groundwater beneath their property.

Groundwater monitoring would involve monitoring existing wells, and possibly installing additional monitoring wells at or near the Site. Groundwater samples from the wells would be collected and analyzed periodically to evaluate contaminant concentrations and to monitor the extent and direction of contaminant migration.

PW Cost: $428,600
Implementation: 9 - 12 months, 30 year period

ALTERNATIVE GW3A - GROUNDWATER CONTAINMENT, METALS REDUCTION, CARBON ABSORPTION, SURFACE WATER DISCHARGE

Alternative GW3A involves installation of extraction (pumping) wells to capture groundwater at the leading edge of the groundwater contaminant plume to stop its migration offsite. Also, injection wells would be used to change the groundwater flow patterns and effectively "push" the plume into the area influenced by the extraction wells, thereby containing it. The exact well placement and extraction/injection volumes needed to maintain the water table configuration would be developed in the Remedial Design. At present, it is estimated that three wells would be needed. A portion of the extracted water would be discharged to Wards Creek; therefore, it will be necessary to meet the appropriate treatment standards for surface water discharge under the Clean Water Act. To achieve this, the extracted groundwater will first be pumped through a treatment system. The portion of treated water not discharged to Wards Creek would be reinjected. Because of the necessity for treating the groundwater, this alternative is not a true "containment" scheme, which typically includes no provision for treatment.

Extraction wells are wells constructed specifically for pumping and removing groundwater. Based on the area of the groundwater plume and the characteristics of the aquifer(s), extraction wells are placed in a pattern that will cause nearby groundwater to flow toward one of the wells and eventually be removed. Pumps are used to remove the water. As groundwater nearest the well is removed, the water table surface is lowered and a cone-shaped depression forms. With the removal of more water, the extent of this cone expands out for some distance and groundwater within the the area of the depression will flow toward the well. Injection wells operate on the same principle, only in reverse, so that the injected water forms a mound on the groundwater surface. As more water is pumped into the well, groundwater over a larger area flows away from the well. Groundwater between the injection and extraction wells is pushed by the injection mound and pulled by the extraction depression toward the extraction wells. Thus, the contaminant plume is contained by the two mechanisms.

Groundwater treatment would consist of an aeration pretreatment step, a metals treatment step, and an organic contaminant polishing step. Aeration removes manganese and iron; to remove the other metal contaminants of concern, chemical reduction, chemical precipitation, phase separation, and filtration would be used. The sludges from these physical processes are generally hazardous wastes because they are contaminated with heavy metals. These sludges would be disposed of off site at a RCRA hazardous waste landfill. Granular activated carbon absorption would be used as the organic contaminant polishing step. In this step, two similarly sized carbon units would be placed in series. Once the lead unit is exhausted, the backup unit would be switched over to the lead position; while the lead unit is emptied of its spent carbon, refilled with virgin or reactivated carbon, and used as the backup unit. The spent carbon would also be shipped offsite to a RCRA hazardous waste landfill for disposal or, if feasible, reactivated for reuse.

In addition to the extraction wells, injection wells, and treatment processes described above, this alternative would include implementation of all institutional controls and groundwater monitoring described in Alternative GW2, thereby monitoring the effectiveness of the alternative and limiting current and future use of groundwater until cleanup goals are achieved. This alternative will take considerably longer to reach the remediation goals because of the time necessary for the contaminant plume to reach the extraction wells.

PW Cost: $2,740,000
Implementation: 1 year, 75 years O&M

Alternative GW3B - Groundwater Containment, Metals Reduction, Carbon Absorption, POTW Discharge

This alternative is identical to Alternative GW3A, except that the treated groundwater would be discharged to the City of Greer Publicly Owned Treatment Works (POTW) rather than being discharged to Wards Creek or reinjected. Depending on the industrial pretreatment standards required by the City, this alternative may allow certain treatment steps to be omitted from the onsite treatment system. The treatment system effluent would be monitored to ensure compliance with the City's industrial pretreatment standards and any other requirements established by SCDHEC.

PW Cost: $2,557,000
Implementation: 1 year, 75 years O&M

Alternative GW4A - Groundwater Extraction, Metals Reduction, Bioremediation, Surface Water Discharge

Alternative GW4A involves placing extraction wells throughout the contaminant plume to actively remediate the aquifer. This would also prevent further migration of the plume. It would involve installing more extraction wells, removing water from the aquifer at a higher rate, and treating more groundwater than Alternatives GW3A and GW3B. Preliminary groundwater modeling indicates that six wells would be needed to recover the contaminant plume at a total flow rate of 30 gpm. The groundwater would be treated to remove inorganic and organic contaminants. Following treatment, the water would be discharged to Wards Creek. The appropriate permit (Clean Water Act) would be obtained for this discharge. In addition to this treatment scheme for groundwater, institutional controls would be implemented to limit current and future use of groundwater until cleanup goals are achieved, and groundwater monitoring would be performed to monitor the effectiveness of the alternative in achieving the remediation goals.

The primary steps in the groundwater treatment process would be the same as described for Alternatives GW3A and GW3B: an aeration pretreatment step, a metals treatment step and an organic contaminant treatment step. The organic treatment step would employ bioremediation, a controlled natural process in which microbial organisms (such as bacteria) consume organic substances.

In general, bioremediation is a common treatment method widely used at conventional wastewater treatment plants. In this case, submerged fixed-film reactors (SFFRs) would be used to provide organic contaminant removal. Systems using SFFRs have been shown to effectively treat low-concentration waste streams, such as the groundwater found at the Elmore Site; however, pilot scale treatability studies would be required to properly design the treatment facility.

The system consists of vessels or reactors filled with a high surface area medium on which bacterial colonies are grown using an artificial stock solution. Once sufficient film has been grown, the stock solution is replaced with the contaminated groundwater. The groundwater does not contain sufficient nutrients and carbon to sustain the volume of film in the reactor and, consequently, the film begins to decay. However, in an effort to sustain itself, the film scavenges the groundwater for nutrients and carbon sources. This scavenging action removes and degrades organic contaminants. Eventually, the film decays and the reactor must be removed from service so that new film can be grown using the stock solution. In its place, another reactor is put in line, as the reactors are rotated on and off line. SFFRs generally produce a nonhazardous, organic sludge. This sludge would be initially sampled to confirm that it was nonhazardous. The sample results would then be used to determine the proper, offsite disposal method for the sludge. Periodic retesting of the sludge would be necessary.

The treated groundwater would be discharged to Wards Creek. The appropriate permit for such discharge would be obtained.

PW Cost: $2,922,200
Implementation: 12 - 18 months, 30 years O&M

ALTERNATIVE GW4B - GROUNDWATER EXTRACTION, METALS REDUCTION, BIOREMEDIATION, POTW DISCHARGE

This alternative is identical to Alternative GW4A, except that the treated groundwater would be discharged to the City of Greer Publicly Owned Treatment Works (POTW) rather than being discharged to Wards Creek or reinjected. Depending on the industrial pretreatment standards required by the City, this alternative may allow certain treatment steps to be omitted from the onsite treatment system. The treatment system effluent would be monitored to assure compliance with the City's industrial pretreatment standards and any other requirements established by SCDHEC.

PW Cost: $2,739,200
Implementation: 12 - 18 months, 30 years O&M

ALTERNATIVE GW5A - GROUNDWATER EXTRACTION, METALS REDUCTION, AIR/GAS/STEAM STRIPPING, SURFACE WATER DISCHARGE

Alternative GW5A would use the same extraction and treatment steps described above for Alternatives GW4A and GW4B. The primary steps in the treatment system would be an aeration pre-treatment step, a metals treatment step, and an organic contaminant treatment step. The organic treatment would consist of air, steam, or gas stripping. As with the preceding alternatives, institutional controls and groundwater monitoring would also be implemented.

A stripping unit would provide primary organic removal. An air, gas, or steam stripping unit works by fostering a controlled evaporation or "stripping" process. The unit has a "tower" or vertical cylinder, filled with a packing media that provides a large surface area for contact between the water and air. The water to be treated is pumped to the top of the tower and cascades downward through the packing media. Air is blown upward through the bottom of the tower and exits at the top. The ratio of air to water is 50 to 1 or higher. The high volume of air passing over the thin film of water on the packing evaporates (strips) the volatile organic contaminants from the water. In the process, contaminants are transferred from water to air. The off-gases produced may have to be treated using gas phase carbon adsorption before they are released to the atmosphere. Steam stripping operates on much the same principal as air stripping, but uses steam instead of air as its vapor-phase carrier.

To be fully effective, the influent water must be as clear as possible. Therefore, filtration to reduce ***turbidity***, in addition to the aeration step to remove iron and manganese, would be necessary. Also, bench and possibly pilot-scale testing would have to be conducted during remedial design to determine which stripping process should be used, as well as to verify that the process can meet the remediation goals for the organic contaminants.

PW Cost: $2,700,800
Implementation: 12 - 18 months, 30 years O&M

Alternative GW5B - Groundwater Extraction, Metals Reduction, Air/Gas/Steam Stripping, POTW Discharge

Alternative GW5B is identical to Alternative GW5A, except that treated groundwater would be discharged to the City of Greer POTW instead of being discharged to Wards Creek. Depending on the industrial pretreatment standards required by the City, this alternative may allow certain treatment steps to be omitted from the onsite treatment system. The treatment system effluent would be monitored to assure compliance with the City's industrial pretreatment standards and any other requirements established by SCDHEC.

PW Cost: $2,517,500
Implementation: 12 - 18 months, 30 years O&M

EPA'S PREFERRED ALTERNATIVE

After conducting a detailed analysis of all alternatives, EPA selected the following alternative for remediation of the Elmore Waste Disposal Site:

Soil:	Alternative SS6, Offsite Disposal
	Total PW Cost: $305,800
Groundwater:	Alternative GW5B, Groundwater Extraction, Treatment, POTW Discharge Total PW Cost: $2,517,500

Rationale for the Preferred Alternative

EPA selected Alternative SS6, Offsite Disposal, as the best alternative for soil at the Elmore Site. The primary factors in EPA's decision, based on the detailed evaluation conducted in the FS, are the relatively small volume of soil requiring remediation and the need for treatability studies with the other alternatives. Both of these factors affect the implementability of each alternative . The following discussion is based on the numerical rating presented in Tables ES-2 and 4-2 in the FS.

Four of the six soil alternatives, Alternatives SS3 (Stabilization), SS4 (Soil Washing/Stabilization), SS5 (In-Situ Vitrification) and SS6 (Offsite Disposal) meet the two threshold criteria of protecting human health and the environment and meeting ARARs. Considering the primary balancing criteria.next, for short-term effectiveness, all four of these alternatives are rated even. On reduction of toxicity/mobility/volume, Alternative SS5 is rated slightly better than each of the others. Alternatives SS5 and SS6 are rated as the most permanent and effective over the long term. However, Alternatives SS4 and SS5 are considered the least easily implementable of the four. In the case of SS4, this is due to the multiple technologies used and the required treatability study for soils washing. (Also, the cleanup standards from the FS does not mandate that an organic treatment step is necessarily required, although it was considered.) In the case of SS5, the rating is due to the need for a costly site-specific treatability study, made necessary by the lack of useful information from commercial applications at sites, Alternatives SS5 is also very expensive to implement.

The two remaining alternatives, SS3 (Stabilization) and SS6 (Offsite Disposal), were further considered on the implementability criterion. Both are easily implementable, but Alternative SS6 is considered to be the better choice. The relatively small volume of contaminated soil makes it easily implementable because no further studies (treatability studies) will be necessary and because the excavation, testing and disposal procedure is fast and routine. Additionally, although Alternative SS6 costs slightly more than four of the five others, it requires no long-term maintenance of treated onsite wastes, and because no wastes will remain onsite the need for long-term monitoring of the remedy by EPA is eliminated.

Thus, Alternative SS6 was selected as the alternative achieving the best tradeoff among the criteria. It is protective of human health and the environment, meets ARARs, will be effective in the long term, reduces contaminant toxicity and mobility through treatment and disposal in a secure facility, is easily implementable, and is cost-effective.

Groundwater Alternatives GW1 (No Action) and GW2 (Restrictions/Monitoring) do not meet the threshold criteria of protecting human health and the environment and meeting ARARs. Alternatives GW3A and GW3B (Containment) are insufficient in meeting ARARs because of questions concerning reinjection of groundwater and failure to meet the 1986 SARA requirements favoring active remediation of contaminated groundwater rather than containment only. Alternatives GW4A and GW4B (Extraction/Treatment-Bio) and GW5A and GW5B (Extraction/Treatment-Air/Gas/Steam Stripping) (AGSS), were rated even on the five balancing criteria. However, EPA experience with both air/steam/gas stripping and bioremediation suggests that the AGSS treatment would be more easily implemented and more reliable as a long-term remedy than the biological treatment process. Alternative GW5B is preferable because it is anticipated that industrial pretreatment standards can be more readily achieved and maintained over time, as compared with the more stringent requirements for discharge of the treated water to Wards Creek.

As a result of these comparisons, EPA believes that Alternative GS5B is the best alternative for remediation of groundwater at the Site. Employing this Alternative would protect human health and the environment and meet ARARs. The Alternative is easily implementable, will be effective in the long term, and reduce contaminant volume and mobility by treatment of the groundwater.

PUBLIC PARTICIPATION

EPA will hold a public meeting on Thursday, January 14, 1993, to discuss the Preferred Alternative and the other alternatives evaluated in the FS. Officials from EPA and SCDHEC will present a summary of the RI/FS, the remedial alternatives, and explain how the preferred alternative was selected. The public is encouraged to attend this meeting.

EPA is also conducting a 30-day public comment period, from Wednesday, December 30, 1992, until Thursday, January 28, 1993, to receive public input and comments on the Proposed Plan for cleanup of the Elmore Site. Comments on the preferred alternative, other alternatives, or other issues related to Site cleanup are welcome and are an important part of the decision-making process. Comments must be post-marked no later than January 28, 1993. Please send all comments to:

Ralph O. Howard, Jr.
U.S. EPA Region
North Superfund Remedial Branch
345 Courtland Street, NE
Atlanta, GA 30365

EPA will review and consider all comments received during the comment period and the public meeting before reaching a final decision on the most appropriate remedial alternative for Site cleanup (the "remedy"). The Agency's final decision will be issued in the Record of Decision, a legal document that formally sets forth the remedy. A ***Responsiveness Summary***, which contains all of the public comments received and EPA's responses to them, is part of the ROD. A ROD is expected to be completed for the Elmore Waste Disposal Site early in 1993.

For more information on the Site, the Community Relations Program or the Superfund Process, please contact:

Ms. Cynthia Peurifoy
U. S. EPA Region
North Superfund Remedial Branch
345 Courtland Street, N.E.
Atlanta, GA 30365
(404) 347-7791 or 1-800-435-9233

WHAT COMES NEXT

Upon signature of the ROD at EPA Region IV in Atlanta, EPA will evaluate the situation with regard to Potentially Responsible Parties (PRPs) at this Site. If viable PRPs are located, EPA will negotiate with the PRPs to secure performance and funding of the remedy under EPA's oversight. If viable PRPs are not found, EPA will proceed with ***remedial design*** and ***remedial action*** using CERCLA trust funds. The design phase can be expected to begin within three months of ROD signature unless extensive negotiations with PRP(s) occur.

SITE INFORMATION REPOSITORY LOCATION

Greer Branch Library
113 School Street
Greer, South Carolina 29651
Contact: Ms. Joada Hiatt, (803)877-8722

Information available for public review at this location includes background information on the Site and on Superfund, as well as the ***Administrative Record*** for the Site. The AR contains all of the documents EPA will use to select a remedy for the Site: the Remedial Investigation (RI) Work Plans, RI Report, Feasibility Study, Baseline Risk Assessment, and other correspondence and reports concerning the Site. Citizens are encouraged to review this material at their convenience.

GLOSSARY OF TERMS

Administrative Order on Consent (AOC) - A legal and enforceable agreement signed between EPA and potentially responsible parties (PRPs) whereby PRPs agree to perform or pay the cost of site cleanup. The agreement describes actions to be taken at a site and may be subject to a public comment period. Unlike a Consent Decree, an Administrative Order on Consent does not have to be approved by a judge.

Administrative Record - A file which contains all information used by the lead agency to make its of a response action under CERCLA. This file is required to be available for public review and a copy is to be established at or near the Site, usually at the information repository. A duplicate file is maintained in a central location such as a regional EPA and/or state office.

Air Stripping - A treatment system that removes, or "strips" volatile organic compounds from groundwater or surface water by forcing an air stream through the water and causing the compounds to evaporate.

Alternate Concentration Limit (ACL) - Groundwater contaminant concentrations that are allowed to exceed Maximum Contaminant Levels (MCLs) or human health-based concentrations only on the property of the hazardous waste site, provided once the groundwater contamination reaches human receptors or aquatic life, it no longer poses a health threat to that receptor. The reduction in toxicity is usually attributed to degradation, natural attenuation and/or dilution of the contaminant.

Applicable or Relevant and Appropriate Requirements (ARARs) - Requirements which must be met by a response action selected by EPA as a site remedy. "Applicable" requirements are those mandated under one or more Federal or State laws. "Relevant and appropriate" requirements are those which, while not necessarily required, EPA judges to be appropriate for use in that particular case.

Aquifer - An underground rock formation composed of materials such as sand, soil or gravel that can store and supply ground water to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

Background - Refers to samples that are collected away from known contaminated areas of a hazardous waste site. Background samples are used as a means of comparing known contaminated areas to known clean areas in order to determine the relative contamination of a site.

Baseline Risk Assessment - A means of estimating the amount of damage a Superfund site could cause to human health and the environment if not cleaned up. Objectives of a risk assessment are to: help determine the need for action; help determine the levels of chemicals that can remain on the Site and still protect health and the environment; and provide a basis for comparing different cleanup methods.

Bench Scale Treatability Study - See Treatability Study

Carbon Absorption - A treatment system where contaminants are removed from groundwater or surface water when the water is forced through tanks containing activated carbon, a specially treated material that attracts and absorbs a variety of contaminants.

Carcinogen - A substance that is known or suspected to cause cancer.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - A Federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The Acts created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and cleanup abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either:

1) Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work.

2) Take legal action to force parties responsible for site contamination to cleanup the Site or pay back the Federal government for the cost of the cleanup.

Consent Decree (CD) - A legal document, approved and issued by a judge, that formalizes an agreement reached between EPA and potentially responsible parties where PRPs will perform all or part of a Superfund site cleanup. The consent decree describes actions that PRPs are required to perform and is subject to a public comment period.

Effluent - Treated or untreated waste-water which flows from a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface water.

Feasibility Study (FS) - See Remedial Investigation/Feasibility Study.

Groundwater - Water found beneath the earth's surface that fills pores in weathered rock, or within materials such as sand, soil, or gravel. In aquifers, groundwater occurs in sufficient quantities which can be used for drinking water, irrigation and other purposes.

Hazard Index (HI) - A term used in the Baseline Risk Assessment which estimates the exposure effects to noncarcinogenic contaminants at a hazardous waste site. A HI less than 1.0 indicates that a significant hazard is unlikely; a HI greater than 1.0 indicates that there may be a potential hazard at the Site.

Hazard Ranking System (HRS) - A scoring system used by EPA and the state to evaluate relative risks to public health and the environment from releases or threatened releases of hazardous substances. An HRS score is calculated based on actual or potential release of hazardous substances through the air, soils, surface water or groundwater. This score is a primary factor used to decide if a hazardous waste site should be placed on the National Priorities List.

Inorganic Contaminants - Compounds or elements that do not include carbon. Some inorganic contaminants found at the Elmore Site are arsenic, cadmium, chromium, lead, nickel and zinc.

Information Repository - A file containing current information, technical reports, and reference documents regarding a Superfund site. The information repository is usually located in a public building that is convenient for local residents -- such as a public school, city hall, or library.

In-Situ Vitrification - the process of melting waste and soils or sludges "in place" to bind the waste into a glassy, solid mass resistant to leaching.

Leachability - the tendency of soil contaminants to migrate downward and reach groundwater. Contaminants can be carried downward by rainwater percolating down through the soil.

Land Disposal Restrictions (LDRs) - Requirements within the Resource Conservation and Recovery Act, that prohibit the land disposal of hazardous wastes into or on the land unless EPA finds that it will not endanger human health and the environment. EPA has developed levels and methods of treatment that substantially diminish the toxicity of the waste, or the likelihood that hazardous constituents will migrate from the waste, that must be met before the waste is land disposed.

Maximum Contaminant Level (MCL) - The maximum permissible level of a contaminant in water that is consumed as drinking water. These levels are determined by EPA under the Safe Drinking Water Act (SDWA) and are applicable to all public water supplies, including groundwater this is considered a potential water source.

Mg/kg - A weight measurement which relates two units in the metric system. One kilogram (kg) equals approximately 2.2 pounds, and contains 1000 grams. Each gram weighs about the same as a postage stamp. A milligram is 1/1000 of a gram. One mg/kg is the same as one part per million (PPM),

Monitoring Wells - Special wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to determine such things as the direction of groundwater flow and the types and amounts of contaminants present.

Monolith - Term frequently used with solidification. Solidified waste, after it is mixed with Portland cement, will be backfilled in onsite excavation, resulting in a solid, massive and uniform concrete matrix referred to as a monolith.

National Oil and Hazardous Substances Contingency Plan (NCP) - The Federal regulation that guides implementation of the Superfund program.

National Priorities List (NPL) - EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response using money from the Trust Fund. The list is based primarily on the score a site receives using the Hazard Ranking System.

Noncarcinogens - Substances that can cause injury or illness by affecting the body's nervous, respiratory, circulatory, or digestive systems.

Operation and Maintenance (O & M) - Activities conducted at a site after a response action occurs, to ensure that the cleanup or containment system is functioning properly.

Organic Compounds - Compounds containing the element carbon.

PAHs (Polynuclear Aromatic Hydrocarbons) - a class of organic compounds whose structure consists of joined rings of carbon atoms. PAHs are often associated with wood-treating operations such as creosote treatment.

Parts Per Billion (ppb)/Parts Per Million (ppm) - Units commonly used to express low concentrations of contaminants. For example, one gallon of a solvent in one billion gallons water is equal to one part per billion. One ppb is equal to 1/1000 ppm.

Pilot Scale Treatability Study - See Treatability Study.

Plume - A three dimensional zone within the groundwater that contains contaminants and generally moves in the direction of, and with, groundwater flow.

Potentially Responsible Parties (PRPs) - Any individual(s) or company(s) (such as owners, operators, transporters, or generators) potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenever viable PRPs are present, EPA requires PRPs, through administrative and legal actions, to cleanup hazardous waste sites they have contaminated.

Publicly Owned Treatment Works (POTW) - A wastewater treatment facility which is owned by a state, municipality, or intermunicipal or interstate agency.

Pump and Treat System - An active groundwater treatment system which extracts contaminated groundwater from the subsurface by a network of extraction wells and removes the contaminants from the groundwater by various proven treatment technologies.

Record of Decision (ROD) - A public document that explains which cleanup alternative(s) will be used at a National Priorities List site. The ROD is based on information and technical analyses generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

Remedial Action (RA) - The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the National Priorities List.

Remedial Design (RD) - An engineering phase that follows the Record of Decision when technical drawings and specifications are developed for the subsequent remedial action at a site on the National Priorities List.

Remedial Investigation/Feasibility Study (RI/FS) - Two distinct but related studies. They are usually performed at the same time, and together are referred to as the "RI/FS". They are intended to gather the data necessary to determine the type and extent of contamination at a Superfund site, establish criteria for cleaning up the

Site, identify and screen cleanup alternatives for remedial action, and analyze in detail the technology and costs of the alternatives.

Resource Conservation and Recovery Act (RCRA) - A Federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent the creation of new uncontrolled hazardous waste sites.

Responsiveness Summary - A summary of oral or written public comments received by EPA during a comment period on key EPA documents and EPA's responses to those comments. The responsiveness summary is especially valuable during the Record of Decision phase at a site on the National Priorities List, because it highlights community concerns for EPA decision-makers.

Safe Drinking Water Act (SDWA) - Federal law passed in 1974 to ensure water supply systems serving the public would meet minimum standards for the protection of public health. The law was designed to achieve uniform safety and quality of drinking water in the United States by identifying contaminants and establishing maximum acceptable levels.

Submerged Fixed Film Reactor - A vessel or tank containing special, high-surface-area media on which a film of bacteria is grown. When water contaminated with organic compounds is placed in contact with such media, the bacteria can feed on the contaminants and remove them.

Superfund - The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act.

Superfund Amendments and Reauthorization Act (SARA) - Modifications made to CERCLA enacted on October 17, 1986.

Surface Water - Bodies of water that are above ground, such as rivers, lakes, and streams.

Toxicity Characteristic Leaching Procedure (TCLP) - A testing procedure used to determine whether a waste is hazardous or requires treatment. The TCLP test is also used as a monitoring technique to determine whether a treated waste meets the applicable waste extract treatment standard.

Treatability Study - A study designed to verify the usefulness of a specific process or technology in cleaning up contaminated material. Such a study usually includes testing. The testing may be "bench-scale," meaning it can be done experimentally in a laboratory, or "pilot scale," meaning that an actual treatment facility or plant must be built and tested.

Volatile Organic Compound - An organic (carbon-containing) compound that evaporates (volatilizes) readily at room temperature. Examples of VOCs found at the Elmore Site are benzene, methylene chloride, vinyl chloride and trichloroethylene.

TO BE ADDED TO THE MAILING LIST FOR THE
ELMORE WASTE DISPOSAL SUPERFUND SITE
PLEASE COMPLETE THE FOLLOWING AND MAIL TO:

CYNTHIA PEURIFOY
NORTH SUPERFUND REMEDIAL BRANCH
U. S. ENVIRONMENTAL PROTECTION AGENCY
345 COURTLAND STREET, N.E.
ATLANTA, GA 30365

ELMORE WASTE DISPOSAL SUPERFUND SITE
GREER, SPARTANBURG COUNTY, SOUTH CAROLINA
MAILING LIST REQUEST

NAME: ______________________________

ADDRESS: ______________________________

____

PHONE NO.: ______________________________

AFFILIATION: ______________________________

United States
Environmental Protection Agency
Waste Management Division
North Superfund Remedial Branch
South Carolina Section

Cynthia Peurifoy
Community Relations Coordinator
345 Courtland Street, N. E.
Atlanta, GA 30365

Official **Business**
Penalty for **Private** Use $300

Appendix 2
Newspaper Ads

New fighting in Liberia as peace plan ...ed

By Alexandra Zavis
THE ASSOCIATED PRESS

MONROVIA, Liberia -- As negotiators pushed back the deadline for a political settlement in Liberia, government officials on Thursday accused the rebels of launching a fresh push on the beleaguered capital, swollen with refugees from previous fighting.

Sporadic explosions could be heard as a stream of refugees, some clutching rolled-up mattresses and balancing cooking pots on their heads, flowed across the bridge over the St. Paul River, which marks the outer border of the capital.

The government has accused the rebels of launching a new push for the capital, a claim denied by the rebels who say they are only defending their positions.

Rebel officials, in nearby ...na for peace talks, countered government forces attac... their positions Thursday.

Negotiators in Ghana said ... force's Nigerian commander ... expected in Monrovia on Fr...

... would facili... ...acekeepers, the deadline ... Abdulsalami ... er Nigerian ...iating the deadline to

Senate OKs $368.6 billion defense spending package

The U.S. Environmental Protection Agency (EPA) Region 4 and the South Carolina Department of Health and Environmental Control (DHEC) announce the commencement of a Five-Year Review for the Elmore Waste Disposal Superfund Site in Greer, Spartanburg County, South Carolina. Five Year Reviews are intended to evaluate the protectiveness of cleanup actions taken at Superfund sites.

A cleanup of contaminated soil onsite was completed in 1995. Since September 1998, contaminated groundwater at the Site has been captured and treated by a 10-well pump-and-treat system constructed during 1997-98. One change to the groundwater cleanup plan was made in 1994, in that treatment to remove metals from groundwater was determined to be unnecessary. Otherwise, the soil and groundwater cleanup actions comprise the Site Remedy as selected and set forth in EPA's April 1993 Record Of Decision for the site.

EPA and SCDHEC anticipate that this Five-Year review will be completed by September 2003. Public comments and questions on this report are welcome! The report will be available for public review or copying at the Greer Branch of the Greenville County Library in Greer.

For further information please contact:

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Ph: (803) 896-4088
Fax: (803) 896-4292
E-Mail: johnsoms@dhec.sc.gov

NA1153 7-16-03 41

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NA1153 7-16-03 41

Appendix 3
Site Inspection Checklist

I. SITE INFORMATION	
Site name: Elmore Waste Disposal	**Date of inspection:** June 11, 2003
Location and Region: Greer, SC (Reg. 4)	**EPA ID:** SCD 980 839 542
Agency, office, or company leading the five-year review: US EPA Region 4	**Weather/temperature:** Partly cloudy, hot, humid

Remedy Includes: (Check all that apply)

- Landfill cover/containment
- Access controls
- Institutional controls
- ✓ Groundwater pump and treatment
- Surface water collection and treatment
- ✓ Other Monitoring of groundwater and surface water.
- Monitored natural attenuation
- Groundwater containment
- Vertical barrier walls

Attachments: Inspection team roster attached   Site map attached

II. INTERVIEWS (Check all that apply) NOT conducted. see below.

1. **O&M site manager** ______ Name ______ Title ______ Date
   Interviewed at site at office by phone Phone no. ______
   Problems, suggestions; Report attached ______

2. **O&M staff** ______ Name ______ Title ______ Date
   Interviewed at site at office by phone Phone no. ______
   Problems, suggestions; Report attached ______

INTERVIEWS were not judged necessary. Regular contact with POTW officials is maintained.

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ______________________________
Contact ______________________________ ____________________ __________ ______________
Name Title Date Phone no.
Problems; suggestions; Report attached ____
____

Agency ______________________________
Contact ______________________________ ____________________ __________ ______________
Name Title Date Phone no.
Problems; suggestions; Report attached ____
____

Agency ______________________________
Contact ______________________________ ____________________ __________ ______________
Name Title Date Phone no.
Problems; suggestions; Report attached ____
____

Agency ______________________________
Contact ______________________________ ____________________ __________ ______________
Name Title Date Phone no.
Problems; suggestions; Report attached ____
____

4. **Other interviews** (optional) Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

O&M manual	Readily available ✓	Up to date ✓	N/A
As-built drawings	Readily available ✓	Up to date ✓	N/A
Maintenance logs	Readily available ✓	Up to date ✓	N/A

Remarks Manual onsite + elsewhere; logs at Shaw E&I, also in quarterly reports.

2. **Site-Specific Health and Safety Plan** Readily available ✓ Up to date ✓ N/A
   Contingency plan/emergency response plan Readily available ✓ Up to date ✓ N/A
   Remarks B&V; EPA; and at site.

3. **O&M and OSHA Training Records** Readily available ✓ Up to date ✓ N/A "Training"
   Remarks OSHA maintained by system operator, Shaw
   40-hr.

4. **Permits and Service Agreements**

Air discharge permit	Readily available	Up to date	N/A
Effluent discharge	Readily available ✓	Up to date ✓	N/A
Waste disposal, POTW	Readily available ✓	Up to date ✓	N/A
Other permits______	Readily available	Up to date	N/A

Remarks Recently revised by POTW

5. **Gas Generation Records** Readily available Up to date N/A
   Remarks

6. **Settlement Monument Records** Readily available Up to date N/A
   Remarks

7. **Groundwater Monitoring Records** Readily available ✓ Up to date ✓ N/A
   Remarks Quarterly reports

8. **Leachate Extraction Records** Readily available Up to date N/A
   Remarks

9. **Discharge Compliance Records**

Air	Readily available ✓	Up to date	N/A
Water (effluent)	Readily available	Up to date	N/A

Remarks Permit compliance is monitored.

10. **Daily Access/Security Logs** Readily available Up to date N/A
    Remarks

IV. O&M COSTS

1. **O&M Organization**
   State in-house　　Contractor for State
   PRP in-house　　Contractor for PRP
   Federal Facility in-house　　Contractor for Federal Facility
   Other____

2. O&M Cost Records
   Readily available　　Up to date　　[See discussion in Five Year Review Report.]
   Funding mechanism/agreement in place
   Original O&M cost estimate____________________　　Breakdown attached

   Total annual cost by year for review period if available

   From__________ To__________ ________________ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ Breakdown attached
   Date Date Total cost
   From__________ To__________ ________________ Breakdown attached
   Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons: ______________________________

V. ACCESS AND INSTITUTIONAL CONTROLS　Applicable　N/A

A. Fencing

1. **Fencing damaged**　　Location shown on site map　　Gates secured　　N/A
   Remarks____

B. Other Access Restrictions

1. **Signs and other security measures**　　Location shown on site map　　N/A
   Remarks____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented — Yes **No** N/A
Site conditions imply ICs not being fully enforced — Yes **No** N/A

Type of monitoring (e.g., self-reporting, drive by) Observation by O+M system operator
Frequency 2x / week
Responsible party/agency (Shaw E+I, for Black & Veatch, Contractor to EPA) EPA.
Contact ______ ______ ______ ______
Name Title Date Phone no.

Reporting is up-to-date — Yes No **N/A**
Reports are verified by the lead agency — Yes No **N/A**

Specific requirements in deed or decision documents have been met — Yes **No** N/A
Violations have been reported — Yes **No** N/A
Other problems or suggestions: Report attached
Deed restrictions and language, although called for in ROD, are unnecessary to prevent exposure. See discussion in Five Year Review Report.

2. **Adequacy** — **ICs are adequate** ICs are inadequate N/A
Remarks

D. General

1. **Vandalism/trespassing** Location shown on site map **No vandalism evident**
Remarks Not an issue since system start-up in 1998.

2. **Land use changes on site** **N/A**
Remarks

3. **Land use changes off site** N/A
Remarks Minor changes south of groundwater pumping area. Nothing significant.

VI. GENERAL SITE CONDITIONS

A. Roads Applicable N/A

1. **Roads damaged** Location shown on site map **Roads adequate** N/A
Remarks "Sunnyside Circle re-paved in 1999.

B. Other Site Conditions NONE

Remarks____

VII. LANDFILL COVERS Applicable N/A

A. Landfill Surface

1. **Settlement** (Low spots) Location shown on site map Settlement not evident
Areal extent____________ Depth____________
Remarks____

2. **Cracks** Location shown on site map Cracking not evident
Lengths____________ Widths____________ Depths____________
Remarks____

3. **Erosion** Location shown on site map Erosion not evident
Areal extent____________ Depth____________
Remarks____

4. **Holes** Location shown on site map Holes not evident
Areal extent____________ Depth____________
Remarks____

5. **Vegetative Cover** Grass Cover properly established No signs of stress
Trees/Shrubs (indicate size and locations on a diagram)
Remarks____

6. **Alternative Cover (armored rock, concrete, etc.)** N/A
Remarks____

7. **Bulges** Location shown on site map Bulges not evident
Areal extent____________ Height____________
Remarks____

8.	**Wet Areas/Water Damage**	Wet areas/water damage not evident	
	Wet areas	Location shown on site map	Areal extent______________
	Ponding	Location shown on site map	Areal extent______________
	Seeps	Location shown on site map	Areal extent______________
	Soft subgrade	Location shown on site map	Areal extent______________
	Remarks____		
9.	**Slope Instability** Slides	Location shown on site map	No evidence of slope instability
	Areal extent______________		
	Remarks____		

B. Benches Applicable N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1.	**Flows Bypass Bench**	Location shown on site map	N/A or okay
	Remarks____		
2.	**Bench Breached**	Location shown on site map	N/A or okay
	Remarks____		
3.	**Bench Overtopped**	Location shown on site map	N/A or okay
	Remarks____		

C. Letdown Channels Applicable N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1.	**Settlement**	Location shown on site map	No evidence of settlement
	Areal extent______________	Depth____________	
	Remarks____		
2.	**Material Degradation**	Location shown on site map	No evidence of degradation
	Material type______________	Areal extent____________	
	Remarks____		
3.	**Erosion**	Location shown on site map	No evidence of erosion
	Areal extent______________	Depth____________	
	Remarks____		

4. **Undercutting** Location shown on site map No evidence of undercutting
Areal extent_______________ Depth____________
Remarks____
____

5. **Obstructions** Type______________________ No obstructions
Location shown on site map Areal extent_______________
Size____________
Remarks____
____

6. **Excessive Vegetative Growth** Type_____________________
No evidence of excessive growth
Vegetation in channels does not obstruct flow
Location shown on site map Areal extent_______________
Remarks____
____

D. Cover Penetrations Applicable N/A

1. **Gas Vents** Active Passive
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance
N/A
Remarks____
____

2. **Gas Monitoring Probes**
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks____
____

3. **Monitoring Wells** (within surface area of landfill)
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks____
____

4. **Leachate Extraction Wells**
Properly secured/locked Functioning Routinely sampled Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks____
____

5. **Settlement Monuments** Located Routinely surveyed N/A
Remarks____
____

E. Gas Collection and Treatment	Applicable	N/A
1. **Gas Treatment Facilities** Flaring / Thermal destruction / Collection for reuse Good condition / Needs Maintenance Remarks______________________		
2. **Gas Collection Wells, Manifolds and Piping** Good condition / Needs Maintenance Remarks______________________		
3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) Good condition / Needs Maintenance / N/A Remarks______________________		

F. Cover Drainage Layer	Applicable	N/A
1. **Outlet Pipes Inspected** Remarks______________________	Functioning	N/A
2. **Outlet Rock Inspected** Remarks______________________	Functioning	N/A

G. Detention/Sedimentation Ponds	Applicable	N/A
1. **Siltation** Areal extent__________ Depth__________ N/A Siltation not evident Remarks______________________		
2. **Erosion** Areal extent__________ Depth__________ Erosion not evident Remarks______________________		
3. **Outlet Works** Functioning N/A Remarks______________________		
4. **Dam** Functioning N/A Remarks______________________		

H. Retaining Walls	Applicable	N/A	
1.	**Deformations** Horizontal displacement____________ Rotational displacement____________ Remarks____	Location shown on site map Vertical displacement_______________	Deformation not evident
2.	**Degradation** Remarks____	Location shown on site map	Degradation not evident
I. Perimeter Ditches/Off-Site Discharge	Applicable	N/A	
1.	**Siltation** Areal extent______________ Remarks____	Location shown on site map Depth____________	Siltation not evident
2.	**Vegetative Growth** Vegetation does not impede flow Areal extent______________ Remarks____	Location shown on site map Type____________	N/A
3.	**Erosion** Areal extent______________ Remarks____	Location shown on site map Depth____________	Erosion not evident
4.	**Discharge Structure** Remarks____	Functioning	N/A
VIII. VERTICAL BARRIER WALLS	Applicable	N/A	
1.	**Settlement** Areal extent______________ Remarks____	Location shown on site map Depth____________	Settlement not evident
2.	**Performance Monitoring** Type of monitoring__________________________ Performance not monitored Frequency___________________________ Head differential___________________________ Remarks____	Evidence of breaching	

IX. GROUNDWATER/SURFACE WATER REMEDIES	Applicable	N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines Applicable N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   Good condition All required wells properly operating Needs Maintenance N/A
   Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   Good condition Needs Maintenance
   Remarks

3. **Spare Parts and Equipment**
   Readily available Good condition Requires upgrade Needs to be provided
   Remarks Stock of certain parts maintained on-site.
   + fittings

B. Surface Water Collection Structures, Pumps, and Pipelines Applicable N/A

1. **Collection Structures, Pumps, and Electrical**
   Good condition Needs Maintenance
   Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   Good condition Needs Maintenance
   Remarks

3. **Spare Parts and Equipment**
   Readily available Good condition Requires upgrade Needs to be provided
   Remarks

C. Treatment System Applicable N/A
1. **Treatment Train** (Check components that apply) Metals removal Oil/water separation Bioremediation Air stripping Carbon adsorbers Filters sediment (bag) Additive (e.g., chelation agent, flocculent) N/A Others Good condition Needs Maintenance Sampling ports properly marked and functional ✓ Sampling/maintenance log displayed and up to date not displayed on ea. piece but is up-to-date. Equipment properly identified Quantity of groundwater treated annually @ 6 million gals. Quantity of surface water treated annually N/A Remarks
2. **Electrical Enclosures and Panels** (properly rated and functional) N/A Good condition Needs Maintenance Remarks
3. **Tanks, Vaults, Storage Vessels** N/A Good condition Proper secondary containment Needs Maintenance Remarks
4. **Discharge Structure and Appurtenances** N/A Good condition Needs Maintenance Remarks
5. **Treatment Building(s)** N/A Good condition (esp. roof and doorways) Needs repair Chemicals and equipment properly stored Remarks
6. **Monitoring Wells** (pump and treatment remedy) Properly secured/locked Functioning Routinely sampled Good condition All required wells located Needs Maintenance N/A Remarks
D. Monitoring Data
1. Monitoring Data Is routinely submitted on time ✓ Is of acceptable quality ✓ US EPA R4 Lab - Athens GA
2. Monitoring data suggests: → issues. See Report. UNCLEAR Groundwater plume is effectively contained Contaminant concentrations are declining

D. Monitored Natural Attenuation N/A

1. **Monitoring Wells** (natural attenuation remedy)
Properly secured/locked Functioning Routinely sampled Good condition
All required wells located Needs Maintenance N/A
Remarks____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

- Surface water and other data from 2002-03 indicate problems with capture; plume delineation; and yields of system wells.
- These issues are discussed in the report.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

[See Report]

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.
	[See Report.]
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.
	[See Report.]

Site Inspection - Five-Year Review
Elmore Waste Disposal NPL Site
Sign-in Sheet
6-11-2003

Name	Affiliation	phone / email
1. Ralph O. Howard Jr.	US EPA	404/562-8829 Howard.Ralph@epa.gov
2. Richard Haynes	SCDHEC	803/896-4070
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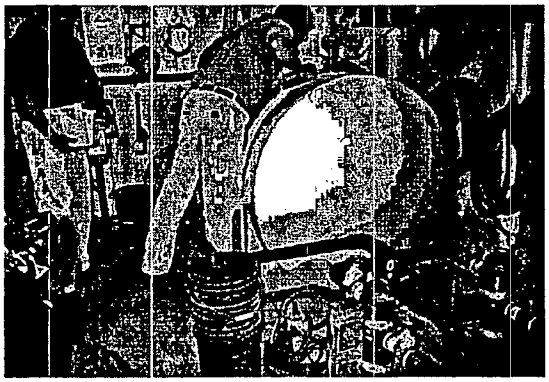
Appendix 4
Final RSE Report

Remediation System Evaluation

for




Elmore Waste Disposal Superfund Site

Greer, South Carolina

Report of the Remediation System Evaluation,
Site Visit Conducted at the Elmore Waste Disposal Site
19-20 September 2000

FINAL REPORT
April, 2001

US Army Corps or Engineers

US Environmental Protection Agency

EXECUTIVE SUMMARY

The Elmore Waste Disposal, Inc. Superfund site is located in Greer, South Carolina. The original Elmore Site occupies approximately half an acre between South Carolina Route 290 on the south, a CSX rail line on the north and is bounded on the west by property parcel 105 which contains an abandoned tavern, and a private residence on the east. An area of single family homes lies approximately 700 to 1100 feet to the north of the Elmore property, beyond the CSX rail line extending to Ward Creek which bounds the subdivision property on the north.

Contaminated waste oil and possibly other liquids were stored on site in a variety of containers. In June – August 1986, approximately 5,000 cubic yards of contaminated soil and 16,840 pounds of liquid were removed under the direction of the South Carolina Department of Health and Environmental Control. Ground water monitoring wells were installed and revealed contamination by volatile organic compounds (VOCs). The site was added to the NPL in March, 1989.

A ground water extraction and treatment facility was built to contain and remediate the contaminated ground water plume. The EPA RPM indicated the plant has been successfully operated for theeight months prior to the RSE team visit.

The RSE suggests several potential modifications to address effectiveness issues:

- Additional characterization is recommended to better define the plume.
- A formal capture zone analysis that incorporates additional hydrogeologic analysis is recommended.
- Indoor air sampling should be conducted at a few homes along Sunnyside Drive along Highland Avenue and Sunnyside Circle to determine indoor air impacts of VOCs.
- Surface water sampling should be conducted to determine impacts on the creek.

The RSE also suggest several potential modifications to reduce long-term costs:

- A reevaluation of the treatment criteria is warranted given the influent concentrations relative to the standards for discharge to the sewer system. This would obviate the need for operating the treatment plant with the exception of monitoring the influent concentrations. (Potential estimated savings of $600,000 over a 20-year period)
- Alternatively, obtaining a permit to discharge treated water into the creek. (Potential estimated savings of approximately $500,000 over a 20-year period)
- Elimination of the pesticide and SVOCs analyses for the effluent and electronic data transfer may save up to $2,000 annual (potential estimated savings of $40,000 over a 20-year period).

- Modifications to the GAC operations will double the lifetime of the GAC units and still allow the system to meet discharge criteria, and modifications to the service contract for the GAC units will facilitate site operations and prevent the necessity of purchasing three new units. (Potential estimated savings of $195,000 over a 20-year period)

Separate from the above recommendations, substantial cost savings (near $2,000,000) may result if aquifer goals are reconsidered and alternative technologies are used to replace the pump and treat system.

PREFACE

This report was prepared within the context of a demonstration project conducted by the United States Environmental Protection Agency's (USEPA) Technology Innovation Office (TIO). The objective of the overall project is to demonstrate the application of optimization techniques to Pump-and-Treat (P&T) systems at Superfund sites that are "Fund-lead" (i.e., financed by USEPA). The demonstration project was conducted in USEPA Regions 4 and 5.

The demonstration project has been carried out as a cooperative effort by the following organizations:

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Army Corp of Engineers: Hazardous, Toxic, and Radioactive Waste Center of Expertise (USACE HTRW CX)	Dave Becker	12565 W. Center Road Omaha, NE 68144-3869 (402) 697-2655 Fax: (402) 691-2673 dave.j.becker@nwd02.usace.army.mil

The project team is grateful for the help provided by an EPA Project Liaison in each Region. Kay Wischkaemper in Region 4 and Dion Novak in Region 5 were vital to the successful interaction between the project team and the Regional Project Managers (RPM's) during the course of this project, and both actively participated in one Remediation System Evaluation (RSE) site visit conducted in their Region.

The data collection phase of this project included interviews with many RPM's in EPA Regions 4 and 5. The project could not have been successfully performed without the participation of these individuals.

Finally, for the sites where RSE's were preformed, additional participation and substantial support was provided by the RPM's (Ken Mallary and Ralph Howard in Region 4; Steve Padovani and Darryl Owens in Region 5), and their efforts are very much appreciated, as are the efforts of the State regulators and EPA contractors who also participated in the RSE site visits.

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1.0 INTRODUCTION

1.1 PURPOSE

The US Environmental Protection Agency's (USEPA) Technology Innovation Office (TIO) and the US Army Corps of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW CX) are cooperating in the demonstration of the USACE Remediation System Evaluation process at Superfund sites. The demonstration of the RSE's is part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems, such as the MODMAN code.

The Elmore Waste Disposal Site was chosen based on initial screening of pump and treat systems managed by USEPA Region 4 and represented a site with relatively high operation cost and a long projected operating life. One or two sites in Regions 4 and 5 will be evaluated with RSE's in the first phase of this demonstration project. A report on the overall results from these demonstration sites will be prepared and will identify lessons learned, typical costs savings, and a process for screening sites in the USEPA regions for potential optimization savings.

The RSE process is meant to identify cost savings through changes in operation and technology, to evaluate performance and effectiveness (as required under the NCP and "five-year" review), assure clear and realistic remediation goals and exit strategy, and verify adequate maintenance of Government owned equipment. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE included:

Kathy Yager, HQ EPA TIO
Frank Bales, Chemical Engineer, USACE, Kansas City District
Dave Becker, Geologist, USACE HTRW CX
Bob Briggs, HSI GeoTrans (EPA TIO's contractor)
Lindsey K. Lien, Environmental Engineer, USACE HTRW CX
Peter Rich, HSI GeoTrans

1.3 DOCUMENTS REVIEWED

The following documents were reviewed as part of the RSE evaluation:

Author	Date	Title/Description
EPA	4/26/1993	ROD (and one ESD)
Bechtel	11/1995	Remedial Design Report
EPA	9/1998	Preliminary Closeout Report
Bechtel	4/1999	Interim Remedial Action Report
Bechtel	Q1/1999	Quarterly Monitoring Report, First Quarter 1999
Earth Tech	4/1999	Ground water Treatment System Design Report
Earth Tech/Bechtel	4/1999	Operation and Maintenance Manual
IT Group	6/1999	Individual Well Extraction Volumes for the Month of June, 1999
IT Group	7/2000	Ground water Extraction and Treatment System, Monthly Operations/Progress Report
Black and Veatch	7/15/2000	Annual Report and 2nd Quarter 2000 Monitoring Report

1.4 PERSONS CONTACTED

The following individuals were present during the site visit:

Ralph Howard, Remedial Project Manager, EPA Region 4
Ed Hicks, O & M Manager, Black and Veatch Special Projects Corporation
Alan Alewine, Site Operator, IT Group
Lucas Berresford, South Carolina Department of Health and Environmental Control
Greg Cassidy, South Carolina Department of Health and Environmental Control
Minda Johnson, South Carolina Department of Health and Environmental Control
Ed Bave, Regulatory Specialist, USACE HTRW CX
Mark Fisher, Industrial Hygienist, USACE HTRW CX
Jim Cheney, Chemist, USACE HTRW CX

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The site is located in Greer, South Carolina near the intersection of State Highway 290 and Sunnyside Drive. The original Elmore Site occupies approximately half an acre between South Carolina Route 290 on the south, a CSX rail line on the north and is bounded on the west by property parcel 105 which contains an abandoned tavern, and a private residence on the east. An area of single family homes lies approximately 700 to 1100 feet to the north of the Elmore property, beyond the CSX rail line extending to Ward Creek which bounds the subdivision property on the north. The Elmore site is relatively flat between route 290 and the CSX rail line. The area slopes significantly to the north of CSX rail line to Ward Creek. The current site layout is shown on Figure 1.1.

1.5.2 POTENTIAL SOURCES

The Elmore Waste Disposal Site is known to have operated from 1975 to 1977; however, aerial photos reveal the presence of what was assumed to be a tanker truck receiving waste material taken as early as 1965. The company received and placed numerous drums containing various liquid and solid wastes. The drums were in various stages of decay. Contaminated waste oil and possibly other liquids were also stored on site in open topped tanks with an estimated volume of 5000 – 6000 gallons. In June – August 1986, approximately 5,000 cubic yards of contaminated soil and 16,840 pounds of liquid were removed under the direction of the South Carolina Department of Health and Environmental Control. Ground water monitoring wells were installed and revealed contamination by barium, cadmium, zinc, tetrachloroethene, trichloroethene, and 1,1,2-trichloroethane. The site was added to the NPL in March, 1989.

1.5.3 HYDROGEOLOGIC SETTING

Ground water occurs in residual soils and weathered and fractured biotite gneiss. Site soils are primarily silty clays and clayey silt and are from 0 - 30 feet thick. Saprolite extends from 15 to 30 feet below grade and bedrock weathered to various degrees is encountered to depths of over 150 feet. Dips of fractures and foliation are not known. Saprolite and weathered bedrock include slightly weathered but fractured quartz veins that may represent significant ground water flow paths. Ground water is encountered between 1 and over 25 feet below grade at elevations ranging from over 930 feet above mean sea level (msl) to less than 895 feet above msl. A spring was known to exist near the intersection of Sunnyside Drive and Sunnyside Circle and discharged small quantities of water. Regrading and the installation of a collection sump near the location of the spring have eliminated surface discharge. Ground water generally flows from south to north toward Ward's Creek at gradients of approximately 0.04 feet/foot. Previous pump tests have indicated that the hydraulic conductivities of the saprolite and weathered bedrock range from 2E-03 to 2E-04 cm/sec. Based on these hydraulic conductivities and gradient values and a site width of 600 feet and a saturated thickness of 60 feet, approximately 20 gallons per minute of ground water flow beneath the site in the contaminated zone. The degree to which ground water flow is focused in fractures is not clear and so the degree to which the pump test values represent the entire site is not known. As described below, extraction well flow rates are variable and suggest that the aquifer properties are significantly variable. Vertical gradients were generally upward throughout the site in early 2000, but previous work suggests that downward gradients may be observed in southern portion of the study area.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

The ground water plume was defined through the Remedial Investigation, supplemental investigations by EPA and its contractors, the remedial design investigation, and remedy construction and monitoring. The plume, as determined in the second quarter of 2000, consists primarily of various organic compounds, including trichloroethene (TCE), perchloroethene (PCE), breakdown products of those solvents including 1,2 dichloroethene (cis 1,2 DCE) and vinyl chloride (VC), and benzene. Recent maximum levels of PCE and TCE exceed 4,000 ug/L, in several wells along the axis of the plume. Benzene is found in EW-01 on the west side of the upgradient portion of the plume and cis-1,2 DCE (maximum 570 ug/L) and VC (maximum 46 ug/L) are found in the same area and in areas directly downgradient. Although metals were originally thought to be elevated at the site, additional work demonstrated that the metals were not related to site activities. The plume extends approximately 1100 feet from the Elmore Site proper northward to Ward's Creek under the Sunnyside Circle subdivision and has a width of 400 -

800 feet wide. The width of the plume is somewhat poorly constrained to the east by monitoring well cluster 12 and the northward extent of the plume is only constrained by one shallow well, MW-02, north of Ward's Creek. Sampling of Ward's Creek both upstream and downstream of the projected extent of the plume suggests discharge of contamination from the ground water into surface water and 5 - 25 ug/L of TCE and approximately 5 ug/L of PCE has been measured at the downstream sampling station. The creek is estimated to have a base flow of 2.5 cubic feet/sec. This base flow was estimated by the RPM at the end of the RI, using a simple field method (flow-rate and stream cross-sectional area). However, it is only an estimate and represents only one measurement at one point in the seasonal/climate cycle. The spring near the intersection of Sunnyside Drive and Sunnyside Circle was contaminated with VOCs. The plume is primarily shallow near the northern edge of the Elmore Site proper but appears to deepen as it migrates to the north under the subdivision. The vertical extent of the plume near the creek is not clear.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The remediation system consists of :

- 9 extraction wells
- 1 spring sump
- extraction pumps, double wall transfer piping to the treatment facility
- 525 gallon equalization tank
- a bag filter system, 2 - 100 filters in series
- 3-1000 pound granular activated carbon adsorbers 2 operated in series with one standby
- an NPDES composite sampler monitoring station
- discharge to the sanitary sewer
- remote operation and control system

The system was designed to treat a flow rate of 30 gpm from the nine extraction wells, and one spring sump. The actual flow discharged from the treatment facility generally averaged approximately 10 gpm during the second quarter of 2000. The maximum allowable discharge rate to the sanitary sewer system is 50,000 gallons per day or approximately 35 gallons per minute. Iron bacteria fouling has not been a problem in the extraction well network.

2.2 EXTRACTION SYSTEM

The extraction system includes nine wells, and a spring sump. The nine wells are 6-inch diameter stainless steel and have approximately 30 feet of screen (except wells EW-05I and EW-06I which have 60 feet and 40 feet), and a two-foot-long sump. Well depths are 48-50 feet for the shallow wells and 80-83 feet for the intermediate depth wells. Each well is supplied with a Grundfos submersible (5S or 10S) pump and pressure transducer. The well head is completed at grade inside a locked flush-mount vault. The connections to the extraction piping, flow-control ball-valve, flow meter, and sample port are all contained inside the vault. Power and control lines are run in below-grade conduits parallel to the collection piping.

2.3 TREATMENT SYSTEM

Ground water is extracted from a series of nine wells and a spring sump that discharged via HDPE polyethylene double walled piping to a 525-gallon equalization storage tank. Flow is then pumped via a float controlled 50 gpm centrifugal pump through bag filters and then to the three 1000 pound granular activated carbon units (two in series, with one in standby mode). The effluent is then discharged via a 3-inch gravity sewer to the Greer South Tyger Wastewater Plant via the sanitary sewer system. The treatment system was designed to treat at a continuous rate of 30 gpm with a peak capacity of up to 50 gpm. Maximum allowable discharge rate to the sanitary sewer is nearly 35 gpm.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The goal of the remedial action, as documented in the ROD dated April 26, 1993, is to both contain and remediate the ground water to specific goals. Ground water clean-up goals are based on either MCLs, proposed State MCLs, EPA action levels, or health-based remediation goals. Chemical-specific ground water cleanup goals include:

benzene	5 ug/l	methylene chloride	5 ug/l
beryllium	4 ug/l	nickel	100 ug/l
cadmium	5 ug/l	PCE	5 ug/l
carbon tetrachloride	5 ug/l	1,1,1-TCA	200 ug/l
chromium	100 ug/l	1,1,2-TCA	5 ug/l
cis-1,2-DCE	70 ug/l	TCE	5 ug/l
lead	15 ug/l	vanadium	200 ug/l
manganese	3,000 ug/l	vinyl chloride	2 ug/l.

Because no one uses ground water in the vicinity and indoor air quality sampling accomplished in 1994 indicated no measurable concentrations of site contaminants, there are no current human exposures, with the possible exception of direct contact with and ingestion of water from Ward's Creek. According to the EPA Region IV RPM Ralph Howard, the remedy is as stated in the ROD, but in the absence of people using well water, the remedy is intended to prevent discharge of contaminated water into the creek at levels that would present a human health or ecological risk. An ESD dated January, 1994 identified metals contamination as a product of the sampling process, and eliminated metals from consideration as site contaminants.

The plant is required to meet discharge standards for the publicly owned treatment works (POTW) set by the City of Greer. Currently, the primary standard is a limit of 2130 ug/l total VOCs. The plant must also monitor levels of pesticides in the effluent. Currently, influent concentrations are approximately 2300 ug/l total VOCs. Pesticides are not found in the influent or effluent.

3.2 TREATMENT PLANT OPERATION GOALS

The current contract for operations calls for the plant to operate 24 hours per day, seven days a week while treating water from all designated active extraction wells. The facility is visited weekly and is remotely monitored 24 hours per day, seven days a week with one individual on call to respond to trouble alarms at the facility. Extraction wells are operated in a manner that prevents frequent cycling of the wells. Pump on/off set points are selected to allow near continuous operation. The plant has been consistently meeting the primary effluent standard limit of 2130 ug /l total VOCs through the GAC system. The plant has consistently been removing VOCs to levels that would meet drinking water standards.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

In general, the RSE team found the system to be well operated and maintained. The observations and recommendations given below are not intended to imply a deficiency in the work of either the designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers. The RSE team found the site operators and the remedial project manager very interested in improving the performance and cost effectiveness of the system. The site operators have been working very diligently to optimize the treatment plant and overcome unanticipated problems.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Water levels in monitoring wells outside of the extraction capture zones show little seasonal fluctuation and flow directions do not vary significantly. The available monitoring wells make determination of the composite cone of depression for the southern (shallow) line of wells difficult to determine. There is better evidence for a cone along the northern (intermediate depth) line of extraction wells. There is a strong vertical gradient near the northern line of wells. Maps of piezometric levels at the site have previously been constructed using the extraction well pump set point elevations but this approach should be avoided since the extraction well water levels do not reflect aquifer levels due to the well losses.

Water was observed in the ditch adjacent to Sunnyside Drive during the site visit. The source of this water is not clear, but a drainage pipe apparently originating from the southwest discharges to the ditch downstream of the driveway to the treatment plant.

4.2.2 CAPTURE ZONES

Based on the limited monitoring network, the determination of the capture zones for the two lines of extraction wells is difficult. There is uncertainty in the current extent of the plume east of EW-10S, and if there is a lack of capture along the shallow well line, it occurs in this area. Temporary well installation and sampling in 1997 east of the location of EW-10S suggested that the eastern edge of the plume was not much farther east of EW-10S. Without the operation of the sump (EW-09), there is also some concern about the capture of the western edge of the plume. The capture zone for the northern intermediate depth well line is also subject to uncertainty to the east but since the average flow rates for the northern line of wells is higher, especially in EW-02I and EW-04I, the capture zone seems to be broader in this area. Temporary shallow well sampling in 1997 east of the north line wells also suggested a nearby limit to the plume. Assuming a pre-pumping gradient of approximately 0.05 and hydraulic conductivity of 1E-3 cm/sec (a conservative number between the 2E-3 and 2E-4 cm/sec values determined from previous pump testing of EW-01S), the flow occurring within a 600-foot-wide and 50-foot thick plume is:

$$Q = kIA = 1E\text{-}3 \text{ cm/sec} * 0.05 \text{ cm/cm} * (600*50) \text{ sq ft} * (30.48 \text{ cm/ft})^2 * 1 \text{ L}/1000 \text{ cu cm} = 1.4 \text{ L/sec}$$

(note that 1.4 L/sec * 60 sec/min * 1 gallon/3.78 L = 22 gal/min)

This is approximately twice the average flow rate of the extraction system. The extraction system averaged under 11 gal/min in the 2nd quarter of 2000. This would indicate inadequate capture. If the hydraulic conductivities are lower, the pumping rate may be adequate, but significant heterogeneity is suggested by the production rates of the extraction wells. Certain wells including wells EW-05I and -06I, appear to have adequate capacity to pump more water than they are currently producing nearer the treatment plant's allowable 35 gal/min discharge rate to the POTW.

The hydraulic conductivities cited above were derived from a pump test of EW-01S. Water level responses in EW-06I due to pumping in adjacent wells EW-04I and EW-02I (when EW-06I was not pumped) were analyzed to estimate hydraulic conductivities at the intermediate depths. On 8/26/98, pumping occurred in EW-04I and EW-02I for almost 4 hours without pumping in EW-06I, after a prolonged shut down of the entire system. Using the hourly water level readings from EW-06 and the Jacob straight-line method, a transmissivity of between 0.006 and 0.008 sq ft/min were estimated. This compares well with the 0.0057 sq ft/min determined by Bechtel (1995) for MW-14I while pumping EW-01S, but approximately an order of magnitude lower than the transmissivity computed by Bechtel using the more appropriate pump test response data from MW-14S. This suggests that the hydraulic conductivities in the intermediate depths may be somewhat lower than the shallow depths, but there is a large uncertainty with these results. Again, if the hydraulic conductivities at the intermediate depths are lower than assumed in calculating the natural flow in the aquifer, the capture of the intermediate depth extraction wells would actually be better than indicated.

4.2.3 CONTAMINANT LEVELS

Contaminant levels in Ward's Creek have appeared to decline over time, as indicated by Figure 4-3 in the 2nd Quarter 2000 report (BVSPC, 2000). This would suggest that the system is affecting the plume in a way that reduces the discharge of contaminants to the creek. Based on the available concentration data for the monitoring and extraction wells since start-up, the extraction system appears to be reducing concentrations of TCE and to a lesser extent PCE in the southern shallow portion of the site. The northern intermediate depth system is significantly reducing concentrations in the deeper portion of the aquifer, but is not clearly impacting the intermediate depth aquifer. Concentrations of both TCE and PCE are increasing MW-01I and EW-06I and EW-04I on the eastern side of the northern line, and concentrations are decreasing somewhat or have no trend in EW-03I, EW-05I, and EW-02I. The higher concentrations on the east side of both the northern and southern extraction lines and the increasing trends in wells on the eastern side of the northern line of wells suggests that the line locations are centered west of the major axis of the plume. The slow rates of decline in wells with higher concentrations of PCE and TCE indicate that the time to achieve MCLs in the entire aquifer will be very great.

There is a concern that the plume may not completely discharge to Ward's Creek. The observed VOC concentrations in the surface water can be used to estimate the degree to which the plume is "captured" by the creek. It can be assumed that the mass of VOCs observed in the surface water of the creek is due entirely to contaminated ground water discharge. If so, the 9 gal/min ground water flow in the plume must discharge to the stream with an average concentration of 500-1000 ug/L of VOCs and be diluted by the 2.5 cubic ft/sec flow in the creek. A weighted average of the concentrations in the plume was computed at approximately 1000 ug/L total VOCs. Based on the similarity in the weighted average concentration in the ground water and the contaminant mass estimated to be discharging to the stream, it would appear that the plume may be largely discharging to the stream and not bypassing it.

4.2.4 NATURAL ATTENUATION POTENTIAL

Concentrations of PCE/TCE breakdown products such as cis 1,2 DCE and vinyl chloride are highest on the west side of the plume coincident with and downgradient of the area of benzene contamination in ground water and the small dump area previously removed just east of Sunnyside Drive. Ratios of TCE to PCE also suggest reduction of the PCE to TCE in the same area. The hydrocarbons were probably present in adequate quantities to drive the aquifer into reducing conditions which led to reductive dechlorination of the more chlorinated ethenes.

4.3 TREATMENT SYSTEM DOWN-TIME

The system does not have a contractual requirement for the plant to continuously treat water from all active extraction wells for some minimum time percentage. The system has been experiencing significant downtime due to unscheduled maintenance events. These include:

1) cleaning the scale from the wells and transducers;
2) frequent bag filter cleaning caused by high TSS present in the sump discharge;
3) repairing exterior cracks and coatings in carbon vessels associated with the lid flexure due to inadequate vacuum relief; and
4) a variety of control failures caused by power surges, lightning strikes and transducer malfunctions.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF COSTS

Cost information was unavailable during the site visit, nor was it included in the information provided to the RSE Team. Additional research will be done to include this information in the final report. Total annual O & M costs for the project is approximately $180,000 per year which includes staffing and excludes analytical costs. These costs may not be indicative of long-term operational cost due to unforeseen maintenance problems described. Future costs may be 30-40% lower.

4.4.1 NON-UTILITY CONSUMABLES AND DISPOSAL

Consist primarily of GAC, with an estimated annual cost of approximately $12,000 based on the current VOC concentration and flow rate. Using data provided in the O&M manual regarding change out frequency, GAC expenditures would be expected to approach $15 – 20,000 annually.

4.4.2 LABOR

The staff consists of one part time operator. The operator conducts bi-weekly site visits to perform routine maintenance, or other visits as necessary. Note that some labor is expended in preparing a report documenting each site visit. These frequent reports may not be necessary once the system is operating as intended.

4.4.3 SAMPLING AND ANALYSIS

Sampling of approximately 8 monitoring wells and 9 extraction wells occurs quarterly. Certain monitoring wells outside the contaminant plume are sampled annually (MW-02, MW-13S and -13I, MW-12S and -12I). Quarterly sampling includes only volatile organics for the monitoring and extraction wells, and VOCs, semi-volatile organics, and pesticides/PCBs for the influent and effluent from the plant. Treatment plant influent/effluent biological oxygen demand, total suspended solids, chemical oxygen demand, copper, and lead concentrations and pH are determined monthly, as required by the POTW. Monthly effluent samples are analyzed by a local laboratory. The quarterly and semiannual analyses are performed by the EPA. According to the project staff, quarterly sampling requires 3 days labor by 2 persons. This labor cost is probably approximately $3,600. Analytical costs for the monthly effluent samples are approximately $14,000 per year.

4.4.4 TREATED WATER DISCHARGE

Currently, annual costs including power and discharge fees, for treated water disposal to the sanitary sewer line are approximately $20,000

4.5 RECURRING PROBLEMS OR ISSUES

4.5.1 WELLS

The extraction wells have generally performed acceptably. There is no well-defined program to identify well performance problems, but the operators do monitor the cycle times for the wells as an indicator of potential problems. Pumps are pulled and cleaned, if needed, approximately every 6 months. Pumps are activated based on water levels and pump switch set points are set based on achieving a minimum cycle time for the pump rather than achieving a minimum flow rate from each well. The pressure transducers have had problems with encrustation and cleaning or replacement of the transducers is periodically required. Well vaults and monitoring wells appear to be secure and in good shape. The control system had been a cause of system downtime, though the operators have been diligent in correcting this problem. The control system still periodically shows a low-flow alarm for well EW-03. The spring sump has consistently been a source of suspended solids in the treatment plant and the yield from the sump has been low. The sump was not producing water at the time of the site visit and had produced less than 400 gallons in the 2nd quarter 2000.

4.5.2 CARBON UNITS

Based on the intermittent nature of plant operations, and the long shake down period, it is difficult to establish if carbon run times have been as long as anticipated in the O&M manual (dated 4/19/99). Problems with particulate matter from EW09, and repairs to the units make an evaluation of the effectiveness difficult. The 2nd Quarter 2000 report (BVSPC, 2000) indicates 2 of the carbon units were changed out following breakthrough in the first carbon unit. The second unit still had significant treatment capacity remaining, and given the discharge levels to the sanitary sewer are very close to the plant influent concentration, the GAC units should not be changed out until completely exhausted.

4.5.3 TRANSFER PUMP

During the site visit, the transfer pump was making noise, most likely caused by a bearing near failure..

4.5.4 PIPING

The piping within the plant is minimal without obvious problems except the vacuum/siphoning problem related to the GAC units, which has been corrected.

4.5.5 BAG FILTERS

The bag filters are functioning properly since the EW-09 (sump) has been taken off line. The high particulate loading from EW-09 required bag change outs every few days. Since EW-09 has been off line, the bag life has increased to approximately 2 weeks. It should be noted that EPA still has concerns about not capturing the water in the area around EW-09.

4.5.6 SLUDGE HANDLING AND TREATMENT

Very little sludge is generated at the site. Backwash from carbon filters and sediment removed from bag filters is placed in a container, allowed to settle and excess water decanted back to the treatment train. So little sludge has been generated that disposal has not been necessary.

4.6 REGULATORY COMPLIANCE

There are no known exceedances of wastewater pretreatment criteria. The plant influent concentrations are just above the POTW acceptance standards.

4.7 TREATMENT PROCESS EXCURSIONS AND UPSETS, ACCIDENTAL CONTAMINANT/REAGENT RELEASES

4.7.1 CARBON VESSEL LEAKS IN THE PLANT

Exterior cracks formed in the vessels due to the lids flexing caused by a vacuum formed in the vessels after the transfer pump shuts off. This problem was diagnosed and repaired by the O&M staff.

4.7.2 CONTROL MALFUNCTIONS

As alluded to throughout the report, numerous controller problems occurred in the plant which resulted in shut downs. Control system problems resulted in 6 wells being shut down from October, 1999 to early February, 2000 while the problem was diagnosed and corrected. The Hi-level alarm in the 300 gallon equalization tank would stick intermittently during high inflow periods, and was replaced along with the equalization tank. A 525 gallon tank was installed to provide greater operational flexibility should multiple wells come on concurrently, or a large volume of water enter the tank over a short period of time.

4.8 SAFETY RECORD

The plant appears to have had an excellent safety record.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The system appears to be achieving its containment goals based on the available data, though there is uncertainty on the extent of the plume to the east and the fate of the plume near Ward's Creek. Of particular interest is the vertical extent of the plume at the creek. It is assumed that the ground water, and therefore the plume, ascends toward the creek bed such that the plume discharges to the stream. If the weathered bedrock and saprolite structure allow the plume to migrate at depth below the stream, the plume may not be adequately contained to prevent exposures. If ground water levels rise due to increased precipitation and the sump (EW-09) remains inactive, there may be some risk of exposure to contaminated seepage near the sump and damage to the landscaping placed there. Furthermore, the nature of the ground water contamination on the actual Elmore property has not been characterized for some significant period of time.

5.2 SURFACE WATER

There may be current ecological and human exposure to surface water contaminated with chlorinated organics in Ward's Creek. The chlorinated organic concentrations are unlikely to be significant in the aquatic environment and do not exceed freshwater screening levels. The downstream sampling station in the creek is probably 400 feet downstream of the point of intersection between the major axis of the plume and the stream and may represent concentrations after substantial aeration of the surface water. The concentrations of contaminants are likely to be a maximum where the highest concentrations discharge to the stream bed. In addition, the concentrations of contaminants in the ditch along Sunnyside Drive have not recently been quantified.

5.3 AIR

Though there has been sampling of indoor air quality at a selected house or two, the persistent presence of vinyl chloride in the western portion of the plume may still be cause for concern. The clay-rich soil should inhibit vapor migration into the home.

6.0 RECOMMENDATIONS

6.1 RECOMMENDED STUDIES TO IMPROVE EFFECTIVENESS

6.1.1 PLUME DEFINITION

As recommended by the current operators, additional information east of the extraction lines and west of Mason Street would be very useful, as would additional multi-depth monitoring points near Ward's Creek (on both sides of the stream). At least one additional cluster of two monitoring wells is needed east of Sunnyside Circle west of Mason Street. These wells should cost approximately $15,000 to install and sample. An additional cluster of two monitoring wells (one shallow and one intermediate depth) is needed along but south of Ward's Creek midway between MW-02 and the downstream surface water sampling station. An additional intermediate depth well should be installed adjacent to MW-02. These three wells would cost approximately $21,000 to install and sample. Re-sampling of selected monitoring wells on the Elmore property is strongly recommended prior to any well decommissioning as part of site redevelopment. This additional data would greatly assist in assessing the impact on the plume from the past source removal. This re-sampling would cost approximately $1,000.

6.1.2 CAPTURE ZONE ANALYSIS

Once additional monitoring wells have been completed, a formal capture zone analysis should be performed on the basis of measured water levels, plus additional hydrogeologic analysis (i.e., analytical tools and/or a simple ground water flow model). The goal is to better understand the capture zone dynamics at the site and evaluate the adequacy of the current capture zone. It is recommended that this analysis also include simple response (pump) tests for a couple of representative extraction wells, including EW-05I, and/or EW-06I. The tests should be conducted following a system shutdown (done for other reasons such as maintenance) and the recovery of ground water levels to a "static" condition. The test should just consist of the restarting of the pump (at a maximum sustainable rate) and the simultaneous monitoring of the draw down response, on a logarithmically increasing interval, in nearby monitoring and extraction wells over the course of 1-2 days. Based on the draw down response, the transmissivity and storage coefficient should be confirmed for the location. These results can be used to predict the aquifer response and capture zone for the entire system compared to the existing plume. These tests could be done with existing treatment plant personnel at a cost of approximately $800 per well (8 hrs * $45/hour * 2 persons + $80/day rental of recorder/transducers). Data analysis would need to be done by a hydrogeologist or engineer at an estimated cost of approximately $2,000 (32 hours * $60/hour). Total cost of the pump tests would therefore be approximately $5000. Costs of the additional hydrogeologic analysis (i.e., analytical solutions, simple ground water modeling) to evaluate system-wide capture zones would cost approximately an additional $10,000. The additional information on the site hydraulic conductivities provided by the simple pumping tests will be invaluable in determining what flow rates are necessary to capture the contaminants most efficiently. The costs for the pump tests are extremely small compared to annual costs for operations. A numerical ground water model could be used very effectively to determine the optimal pumping configuration and to perform "what-if" analyses, especially if one were to consider alternatives such as a permeable reaction wall. The use of an optimization tool for flow models such as MODMAN would be potentially valuable. Additional information on the use of MODMAN for optimization of pump-and-treat systems used for containment of plumes is available at http://www.frtr.gov/optimization/.

6.1.3 INDOOR AIR IMPACTS

Time-averaged indoor air sampling for VOCs, especially vinyl chloride, could be considered during times of declining barometric pressure for a few homes just east of Sunnyside Drive along Highland Avenue and Sunnyside Circle. Some modeling of the vapor migration, such as the method of Johnson and Ettinger (1991) should be considered using the indoor air sampling results as a calibration point to project indoor vapor concentrations under other conditions. Sampling may cost $5,000 and the modeling analysis may cost an additional $5,000.

6.1.4 SURFACE WATER SAMPLING

A sampling station in the creek due north of wells EW-06I and -4I should be established and sampled at least once to determine the true range of impacts to the stream. Diffusion samplers set on or in the creek bed may be a very cost effective means to achieve a representative chlorinated organic sample. Finally, in order to assure that there are no unquantified risks due to surface water exposure, some sampling of the ditch along Sunnyside Drive for VOCs should be done downstream of the culvert under the back entrance to the treatment plant. Costs for these samples should be less than $1500.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

6.2.1 RE-EVALUATION OF TREATMENT CRITERIA

Given the influent concentrations relative to the standards for discharge to the sewer system, it may be beneficial to seek a slight increase in the discharge standard. The subject should be raised with the City of Greer. This would obviate the need for operating the treatment plant, though not for monitoring influent concentrations. In fact, sampling frequency may need to increase since the influent may still be quite close to a revised standard. The treatment equipment would need to be retained in case concentrations increase. The net savings may be approximately $30,000. As an alternative, the project team could seek the equivalent of a NPDES permit for discharge of the treated water to Ward's Creek or a tributary, such as the ditch along Sunnyside Drive. Such a permit would require substantial administrative effort to meet the substantive requirements, but since this would be an on-site action, the actual permit would not be required. The effluent water is not high in most metals, SVOCs, total dissolved solids, total suspended solids, or pesticides and pH is not extreme. If requirements could be met with the existing treatment plant, annual savings could be $25,000. It should be noted that the RPM recalls that this option was considered in 1997 and dropped (concerns included iron concentrations and the potential need for a treatment system), but agrees that a re-look of this option seems treasonable.

6.2.2 REDUCTION IN MONITORING AND REPORTING REQUIREMENTS

The RSE team concurs with the recommendation of the remedial project manager to eliminate the analysis of effluent for pesticides, SVOCs, and total suspended solids. This will require coordination with the City of Greer. Cost savings are probably less than $2,000/year. The current monitoring program for monitoring and extraction wells appears to be appropriate. Suggest that the operator use electronic data transfer and posting of monitoring results and inspection reports on the Internet to replace current weekly and monthly reports. Any daily reports should be terminated once routine operations are achieved. Cost savings for this have not been quantified.

6.2.3 MODIFY GAC OPERATIONS

Currently, the operating contractors replace the GAC in two of the three contactors upon breakthrough in the lead contactor. The two operating contractors should be allowed to reach complete breakthrough prior to requiring media replacement. This will double the life of the carbon while still allowing the facility to meet its discharge criteria which is very near the plant influent concentration. If the lag contactor should reach full exhaustion (effluent concentration equals or exceeds the influent concentration) the third (standby) vessel should be brought on line to treat the flow until the spent carbon can be replaced. This revision in operations will likely save $5,000 to $10,000 annually. In addition, the use of a service contract should be evaluated to eliminate the need for the operator to handle and dispose of the spent GAC. The service contract should include transportation of replacement vessels including GAC, and removal, regeneration and transportation of the spent GAC and vessels to the service supplier. Annual cost for renting 3-1000 pound contractors is approximately $7,200 plus GAC at about $2/pound in small quantities, including delivery. This option may not save money due to the infrequency of the deliveries, but would simplify facility operations a great deal, and expedite the carbon change out process with no mess, which is desirable in this location. If a service contract is not pursued, then 3 new contractors should be purchased to replace the existing units. Estimated cost of the new vessels is about $25,000.

6.2.4 NATURAL ATTENUATION

Based on the lack of current human exposure to the ground water contaminants, and the potential for only limited human and ecological at Ward's Creek, it may be possible to eliminate the operation of the extraction system entirely and still not present an unacceptable risk. As discussed in section 4.2.4, there appears to be some evidence of reductive dechlorination occurring at the site. Additional modeling of the contaminant transport would be necessary. The additional study of the ground water/surface water interaction would likely need to be revisited to re-evaluate the exposure scenarios. Institutional controls to prevent use of ground water and to reduce exposure to surface water would be vital. This measure may not be acceptable to either the state or public despite the potentially low risk. The time to clean up under natural conditions is likely to be very long, even though the near-surface sources have been removed. This suggestion is made to complete the presentation of options and is not strongly recommended. Potential savings are over $100,000 annually, or $2,000,000 over the life of the project.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 CHANGES TO DATA EVALUATION PROTOCOLS

Recommend that the project team use the EPA data quality objective process or the USACE Technical Project Planning process (refer to USACE Engineer Manual EM 200-1-2, available at http://www.usace.army.mil/inet/usace-docs/eng-manuals/em200-1-2/toc.htm) to refine the strategy for monitoring performance at this site. Suggest those specific criteria for subsurface performance be developed. These criteria could include the achievement of a minimum pumping rate from each extraction line, achievement of a specific drawdown at monitoring wells (based on analytical or numerical models), reductions of concentrations in the creek or in specific monitoring wells, or maintenance of specific inward gradients (again potentially based on modeling results). The USACE

HTRW CX or EPA Ground Water Forum members can advise on this process. The entity with responsibility to assess the monitoring data should be clearly identified. A cost for the development of such a strategy is not easily quantified, but may range from $2,000 to $5,000 above the other costs described above.

6.3.2 GOALS FOR EXTRACTION FROM INDIVIDUAL WELLS

Rather than considering the cycle times for the well operation, a target extraction rate should be selected, based on the overall system goals and the well capacity, for each extraction well. In addition to this approach, the specific capacity of each extraction well should be monitored using the control system and tracked over time as an indication of well fouling or pump problems. The use of test kits, such as BART kits can help in early identification and treatment of biofouling problems. The operators are performing preventative maintenance on the well pumps and transducers and this good practice should continue. Refer to USACE Engineer Pamphlet 1110-1-27 (Jan 2000) for additional information on preventative maintenance. A copy can be accessed at:

http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/ep1110-1-27/toc.htm.

6.4 MODIFICATIONS INTENDED TO GAIN SITE CLOSE-OUT

6.4.1 RECONSIDER CLOSURE CRITERIA

Given the level of effort that has been expended in removals of sources, the ground water quality improvements during two years of operations have been slow. The project team should consider the (un)likelihood of achieving MCLs in the aquifer in a reasonable time. Possibly, a re-evaluation of the ultimate goals for remediation of ground water is appropriate. As suggested by the RPM, the primary goal may really be to limit exposure at the creek. In that case, target ground water concentrations higher than MCLs may still be acceptable for achieving toxicity or carcinogenicity goals for exposure scenarios involving the creek. This would involve careful coordination with the State of South Carolina and probably a ROD amendment. Costs for this action have not been quantified. Cost savings may be significant by shortening the time that the extraction system would have to operate. The life span of the system would be shortened, but this would happen beyond a 20-year period used in this RSE for analysis of costs.

6.5. CHANGES IN CURRENT APPROACH TO SITE REMEDIATION REQUIRING REDESIGN

6.5.1 PERMEABLE REACTION BARRIER

The current use of pump and treat technology could be replaced by the use of a permeable reaction (iron filings) barrier (PRB) installed along the south side of Ward's Creek. Given the low natural ground water flow rate, the shallow depth to water near the creek, and the predominance of chlorinated organics as the contaminants currently of concern at this site, a PRB would be feasible at this site. Such a barrier would prevent discharge of the contaminants into the creek, assuming that the contaminant flow paths can be cut by the barrier. The relationship between the contaminant plume and the surface water must be clarified as recommended above. Assuming a 24-inch-thick PRB with a length of 600 feet and a 35-foot depth (lower 30 feet containing a mix of 2 parts iron to 1 part sand), an estimated cost would be approximately $1,000,000. This includes characterization ($8,000/100'), design ($50,000 lump sum), clearing ($1,000/100'), licensing ($12,000/100'), construction ($10,000/100'), materials (124,000/100'), and monitoring wells (6 wells @ $2,000/100'). In addition, a shorter (200') PRB intended to reduce the concentrations near the source (along Highland Avenue) is also recommended. The cost for this barrier would be approximately 1/3 of the cost for the PRB along the creek or $333,000. Based on a $160,000/year O&M cost for the current system, a payback time (based on avoided costs of operating the treatment plant) of less than 8 years is indicated. However, if O&M costs can be reduced, the payback period may be lengthened to over 10 years and the cost effectiveness may be in question. These costs for a PRB do not include contingencies that also may affect payback time. The lifespan for the iron is not known, but expected to be quite long. There would be significant disruption of the aesthetics near the creek and may make this alternative less desirable for the public. The secondary PRB near the source is recommended to reduce (but not eliminate) the concentrations in the plume and reduce the cost (thickness, iron content) of the wall near the creek and extend its life. If the secondary barrier near the source is not implemented, then the cost of the PRB near the creek would be higher and may require replacement sooner.

6.5.2 IN-SITU BIOREMEDIATION BARRIER

Accelerated anaerobic bioremediation could also be an alternative for containment of the chlorinated solvent plume. A bioremediation barrier would be installed at the same locations and depths as described for the permeable reactive barrier. The bioremediation would be facilitated by a "permeable organic barrier." The approach would use a similar construction approach but would include a mixture of sand and vegetable oil. Additional information is provided as an appendix.

Since a wall configuration for vegetable oil placement has not been constructed previously, the costs for this are not as well defined as some other alternatives. Vegetable oil field demonstrations have not been monitored for a long enough period to determine how frequently replenishment is required. Actual costs may differ from the estimate depending on the longevity of the oil in maintaining anaerobic conditions in the aquifer. Assume all characterization, construction, design, and monitoring well costs are the same as for the iron wall. Using the cost per pound for oil given above and assuming 20% of the volume of the wall is oil, the cost for materials for such a wall would be approximately $600,000 less than for iron filings. In addition, the licensing costs of approximately $100,000 would also be saved. Thus, the total cost may be approximately $600,000. A field demonstration would probably have to be performed prior to placement of any large-scale injection point barrier. The field demonstration would require placement of a small-scale barrier (about 50 feet long), and at least 9 months of ground water monitoring. Periodic replenishment of the oil would be required, but the oil could be injected into the sand backfill using direct push methods at a cost of perhaps $40,000 - 50,000/year.

7.0 SUMMARY

In general, the RSE team found the system to be well operated and maintained. The system effectiveness is subject to some questions, but generally appears to be working. It appears contaminants are continuing to travel towards Ward's Creek adjacent to the site, though at a reduced rate. A number of changes in the remedial approach or the operations of the system are suggested to possibly improve performance and reduce future operations and maintenance costs. These are summarized in the following Cost Summary Table.

The RSE team recognizes the difficulties in implementing changes to the permit under which the system operates and the costs for obtaining regulatory acceptance. If the changes to the treatment process and monitoring program could be proposed as a package to the State of South Carolina, then some time and cost efficiencies could be realized.

The strategy for implementing these recommendations should be:

1. Perform the additional characterization

2. Perform the capture zone analysis and optimization. The optimization of the extraction system should involve the evaluation of the feasibility of either the direct discharge of the extracted (untreated) water into the sanitary sewer or discharge of the treated water into the creek to determine the cost function for the optimization. The optimization goal would be to determine the least costly pumping scenario that still maintains capture of the system.

3. Eliminate the pesticide and SVOCs analyses, make changes to the data evaluation protocols, and set goals for extraction well production.

4. Reconsider aquifer goals and consider the alternative technologies to replace the pump and treat system. Since these recommendations would have many institutional and economic hurdles, the action on these should be made in parallel to the more realistic goals for improvement of the pump and treat system.

Table 7-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($yr)	Estimated Change In Lifecycle Costs ($)*
6.1.2 Capture Zone Analysis	Effectiveness	$5,000	$0	$5,000
6.1.2 Ground water Modeling and Optimization	Effectiveness	$10,000	(Unknown - May be significant)	(Unknown - May be significant)
6.1.1 Plume delineation east of the current extraction lines, along Creek	Effectiveness	$36,000	$7,000	$176,000
6.1.3 Indoor air re-sampling	Effectiveness	$10,000	$0	$10,000
6.1.4 Surface water sampling	Effectiveness	$1,500	$1,500	$31,500
6.2.1 Discharge directly to sewer without treatment	Cost reduction	$0	($30,000)	($600,000)
6.2.1 Discharge treated water to Ward's Creek	Cost reduction	$7,500	($15,000)	($492,500)
6.2.2 Eliminate pesticide and SVOCs analyses	Cost reduction	$0	($2,500)	($50,000)
6.2.3 New GAC Vessels and Revise Change Out	Cost reduction	$25,000	($10,000)	($175,000)
6.2.3 GAC Service Contract	Cost reduction	$0	($1,000)	($20,000)
6.3.1 Changes to data evaluation protocols	Technical Improvement	$2,000-5,000	$0	$2,000-5,000
6.3.2 Goals for extraction well production	Technical Improvement	$0	(Unknown-May be significant)	(Unknown-May be significant)
6.4.1 Reconsider aquifer goals	Site Close-out	Unknown	(Unknown-May be significant in out years)	(Unknown-May be significant)
6.5.1 Permeable Reaction Barrier	Site Close-out	$1,330,000	($160,000)	($1,870,000)
6.5.2 In-situ bio barrier	Site Close-out	$600,000	($160,000)	($2,600,000)

*estimated change in life-cycle costs assumes 20 years, no discount rate. Costs in parenthesis imply a cost reduction.

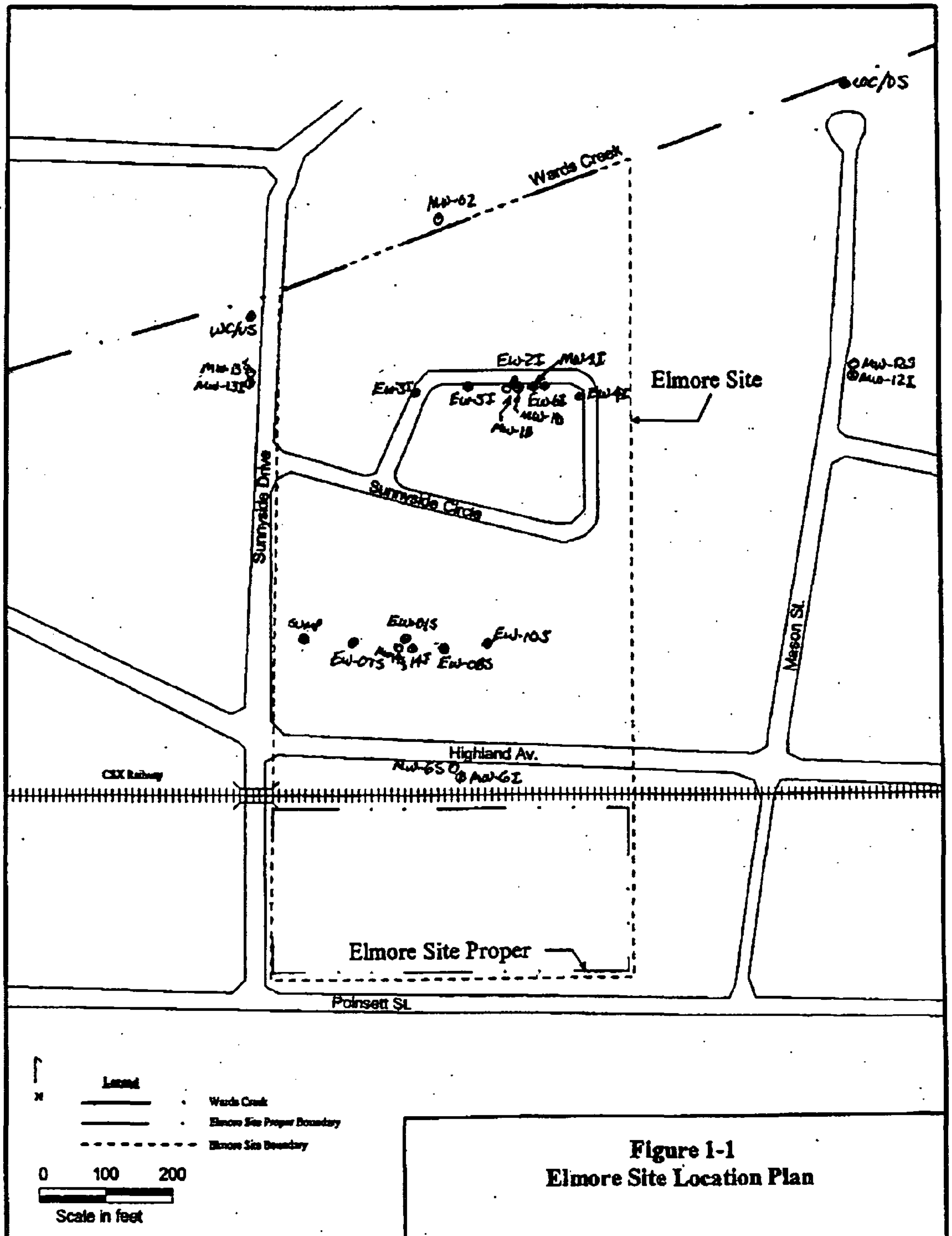
Appendix A - In-Situ Biological Treatment Using Vegetable Oil

Accelerated anaerobic bioremediation process rely on either native or introduced microorganisms to degrade chlorinated solvents such as PCE or TCE to innocuous end-products including ethene and ethane. An organic substrate (electron donor) must be added to the ground water to generate reducing conditions and provide the necessary carbon to support biodegradation of the chlorinated solvents. Organic substrates that have been used include soluble compounds such as benzoate, lactate, propionate, molasses, acetate, or methanol. As stated above, such processes have been inadvertently facilitated on site by the leakage of benzene and other hydrocarbons into the aquifer. Soluble substrates must be added periodically at either high batch dosages or continuously at low dosages to maintain anaerobic conditions. Ground water recirculation is generally necessary to distribute the dissolved organics throughout the contaminated site.

A second category of organic substrates includes relatively insoluble compounds such as the Hydrogen Release Compound (HRC) from Regenesis, and food grade oils. HRC is a polylactate ester that slowly releases lactate into the ground water. Soybean oil has been identified as a candidate oil product and an alternative to HRC for the following reasons: the specific gravity is just slightly less than water (0.93), so that it has a lesser propensity to move toward the surface of the water table than most other oils; it remains liquid even at very low temperatures (down to about -15 degrees C); and because it is extremely inexpensive (about 35 cents per pound). Slow-release substrates need to be added to ground water less frequently than soluble substrates, and may not require a ground water recirculation system. According to Regenesis, the HRC product should be replenished about every 6 to 12 months. Vegetable oil is expected to require less frequent replenishment than HRC, probably about every two years.

The Air Force Center for Environmental Excellence is conducting oil injection field trials of at three Air Force Bases. Injection of pure soybean oil and an emulsion of soybean oil and water are being tested. It is believed that substrate can be more widely and uniformly distributed via injection of an oil-water emulsion than through direct oil injection. Biological activity is expected to be heightened at the oil-water interface. Since the area of the oil-water interface will be much greater for an emulsion than for straight oil, it is expected that use of an oil-water emulsion will result in a more uniformly anaerobic zone.

Figure 1-1. Elmore Site Location Plan



Appendix 5
Draft RSO Report for the Groundwater PTS
at the Elmore Waste Disposal Site (Black & Veatch)

U.S. Environmental Protection Agency

EPA Region 4

RESPONSE ACTION CONTRACT
Contract No. 68-W-99-043

DRAFT
Remediation System Optimization Report

for the

Groundwater Pump and Treat System
Elmore Waste Disposal Superfund Site
Greer, South Carolina

UNITED STATES · ENVIRONMENTAL PROTECTION AGENCY ·

BLACK & VEATCH Special Projects Corp.

[Appendices A and B not included]

Draft

Remediation System Optimization Report
for the
Groundwater Pump and Treat System

Elmore Waste Disposal Superfund Site
Greer, Spartanburg County, South Carolina

Prepared Under
EPA Contract NO. 68-W-99-043
RAC Work Assignment NO. 004-RARA-04N3

for the

Waste Management Division
U.S. Environmental Protection Agency Region 4

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BVSPC Project No. 48104.1417

January 2003

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1.0 Introduction

The United States Environmental Protection Agency (EPA) tasked Black & Veatch Special Projects Corp. (BVSPC) to conduct Operations and Maintenance (O&M) at the Elmore Waste Disposal Groundwater Extraction and Treatment Facility in Greer, Spartanburg County, South Carolina. BVSPC has been conducting O&M at the Elmore site since September 1999, in accordance with the Final O&M Work Plan, dated October 13, 1999.

The EPA Technology Innovation Office (TIO) and the US Army Corps of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW CX) completed a draft Remediation System Evaluation Report (RSE Report) for the Elmore site in December 2000. RSEs are part of a larger TIO effort to provide EPA Regions with methods to identify sites likely to benefit from optimization and computer-modeling optimization tools for pump and treat systems.

The Elmore Waste Disposal Site was chosen for optimization activities from a list of EPA Region 4 pump and treat systems that have significant operating costs and a lengthy projected operating life. Many EPA guidance documents for pump and treat technology acknowledge the need for periodic evaluation and optimization of groundwater pump and treat systems.

This draft Remediation System Optimization Report (RSO Report) has been prepared in response to RAC 4 Contract No. 68-W-99-043, Work Assignment (WA) No. 004-RARA-04N3, Revision 07 of the Statement of Work (SOW), dated May 10, 2001, and modifications discussed with the EPA Remedial Project Manager (RPM), South Carolina Department of Health and Environmental Control (SCDHEC), BVSPC, and IT Corp. to clarify optimization objectives and proposed work.

1.1 Purpose and Scope of Work

This Draft RSO Report presents and evaluates results of groundwater investigation work conducted during late spring and summer 2002, as well as extraction well capture zone analysis and modeling just recently completed. The objective of the investigation and modeling was to determine whether the groundwater contaminant plume is being contained or captured, and whether remediation system operations are being optimized. The following tasks were completed to achieve these objectives:

- Installation of one extraction well to replace the Spring Sump, and installation of nine additional monitoring wells and two piezometers to improve the monitoring well network capabilities.
- Slug testing and analysis to determine hydraulic conductivity in five new wells/piezometers.
- Capture zone analysis/verification and reporting on the effectiveness of the existing remediation systems.
- Plume capture computer modeling.
- Inventory and sampling of wells on the old Elmore property that are no longer being monitored.
- Wards Creek groundwater sampling at numerous points to locate the source(s) of VOCs migrating into the creek and to aid in capture zone analysis.
- Data coordination and evaluation from soil gas sampling for VOCs in site areas above the groundwater contamination plume.
- Investigation and evaluation of potential technical/operational improvements to improve system efficiency and reduce costs.

This report also provides conclusions based on the new work completed and knowledge of historical operations including recommendations for system improvements and additional data needs.

2.0 Background

The Final O&M Work Plan, dated October 13, 1999, presents site background, description, and regulatory history.

3.0 Completed New Field Work

This section presents descriptions and discussions of work completed at the site under the authority of the EPA approved O&M Work Plan Addendum. Table 3-1 lists the new work as described in the Final Work Plan Addendum, the actual work completed, along with the recommended work in the RSE Report.

3.1 New Monitoring Wells and Piezometers

Two new shallow monitoring wells, two shallow piezometers, one shallow extraction well, three intermediate monitoring wells, and four new deep monitoring wells were installed onsite during April, May, and June 2002. Well and piezometer designations follow:

Shallow Zone	Intermediate Zone	Deep Zone
PZ-01S	MW-16 I	MW-02 D
PZ-02S	MW-17 I	MW-16 D
MW-15 S	MW-18 I	MW-17 D
MW-16S		MW-18 D
EW- 09		

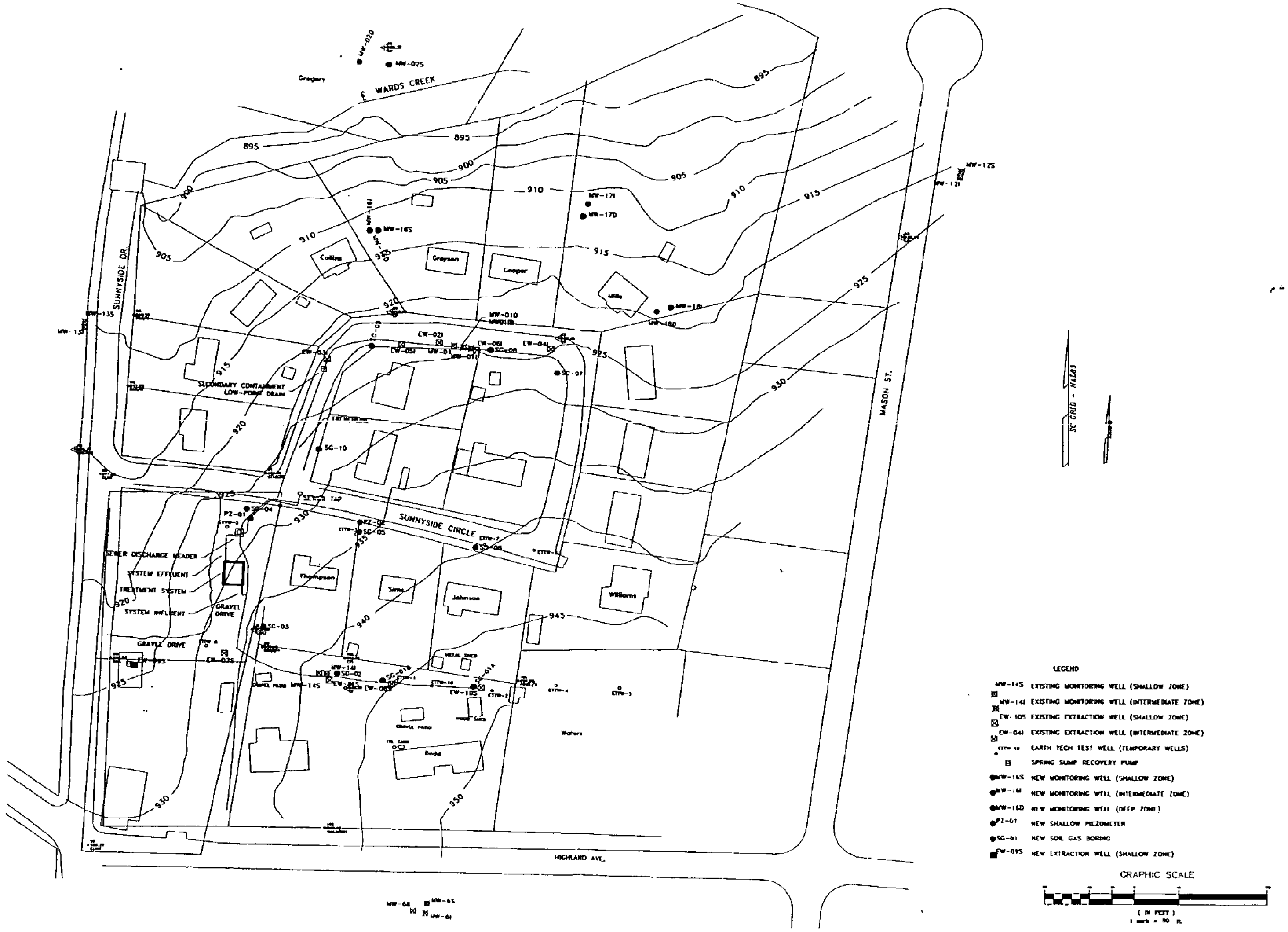
Figure 3-1 presents new and existing onsite well locations. Figure 3-2 presents the September 2002 sampling results for all wells. Table 3-2 also presents this analytical data. The Well Drilling Report, dated August 2002, contains lithologic logs, construction diagrams, well development logs, photos, analytical sampling results, and an updated as-built site map with new well locations. In addition to the well installed by BVSPC, after resolving location and access issues, EPA installed one new shallow well, MW-15S, in August 2002.

3.1.1 Shallow Wells

As indicated in Table 3-2 and on Figure 3-2, the low part per billion VOC detections (11 ug/L VOCs) in MW-15S appear to represent the approximate eastern limit of the onsite shallow aquifer plume. MW-15S was installed with the objective of defining the eastern limit of the shallow VOC plume.

Table 3-1
Comparison of Work Elements Recommended and Implemented During 2002
Elmore Waste Disposal Site, Greer, SC

	RSE Report Recommendations	BVSPC O&M Workplan Addendum	Work Elements Actually Completed at Elmore	Remarks
1	Plume delineation by installing and sampling additional MWs.	Install & sample 10 MWs and 2 PZs.	Installed & sampled 10 MWs and 2 PZs.	Well Drilling Report issued in August 2002.
2	Groundwater modeling and capture zone analysis.	Conduct slug tests, GW modeling, and capture zone analysis.	Conducted slug tests, GW modeling, and capture zone analysis.	Draft Capture Zone Analysis Report issued in October 2002.
3	Indoor air resampling.	Perform soil gas survey.	Soil gas samples collected by EPA at 11 outdoor locations.	EPA Soil Gas Study Report issued August 15, 2002, included as Appendix A of this report.
4	Additional surface water sampling locations.	Collect surface water samples at additional points.	Sample 2 surface water locations along Wards Creek between the normal upstream and downstream locations. Also sample surface water from a ditch near EW-09.	Additional surface water sample locations included in quarterly sampling program.
5	Discharge untreated water to sewer system.	Not addressed.	GAC treatment capacity is currently exhausted. Water is pumped through the GAC into the local sewer. Effluent is tested monthly to ensure DMR limit is not exceeded.	RSE recommendation is essentially being implemented since spent GAC has not been replaced.
6	Discharge treated water to Wards Creek.	Not addressed.	No Action Taken.	NPDES permit would be required.
7	Eliminate pesticide and SVOC analysis within treatment system.	Not addressed.	DMR revised from monthly to quarterly. Eliminated sampling of BOD, COD, TSS. Report TTO, lead, & copper annually.	Less stringent sampling/analysis has been implemented.
8	New GAC vessels and revise GAC change-out.	Not addressed	Not currently necessary.	Not necessary.
9	Procure GAC service contract.	Not addressed.	Not currently necessary.	Not necessary.
10	Change data evaluation protocols.	Not addressed.	No Action Taken.	---
11	Establish goals for extraction well production.	Not addressed.	Minimum daily extraction rates from each EW have been estimated in the Capture Zone Analysis Report.	Several extraction wells are incapable of achieving minimum recommended extraction rates.
12	Reconsider aquifer goals.	---	No Action Taken.	---
13	Install permeable reaction wall.	---	No Action Taken.	---
14	Perform in-situ biological treatment.	---	Evaluation of injecting HRC into GW was conducted by Regensis.	Cleanup goals unlikely to be met. Potential adverse health risks if vinyl chloride is formed.
15	---	Sample pore-water beneath Wards Creek using push point sampler.	Collected pore-water samples beneath Wards Creek from 25 locations at 20-foot intervals.	Results presented in this report.
16	---	Resample old MWs on original Elmore Site.	9 of 12 old MWs sampled at original Elmore property.	Property access an issue on the 3 wells not sampled.



BLACK & VEATCH

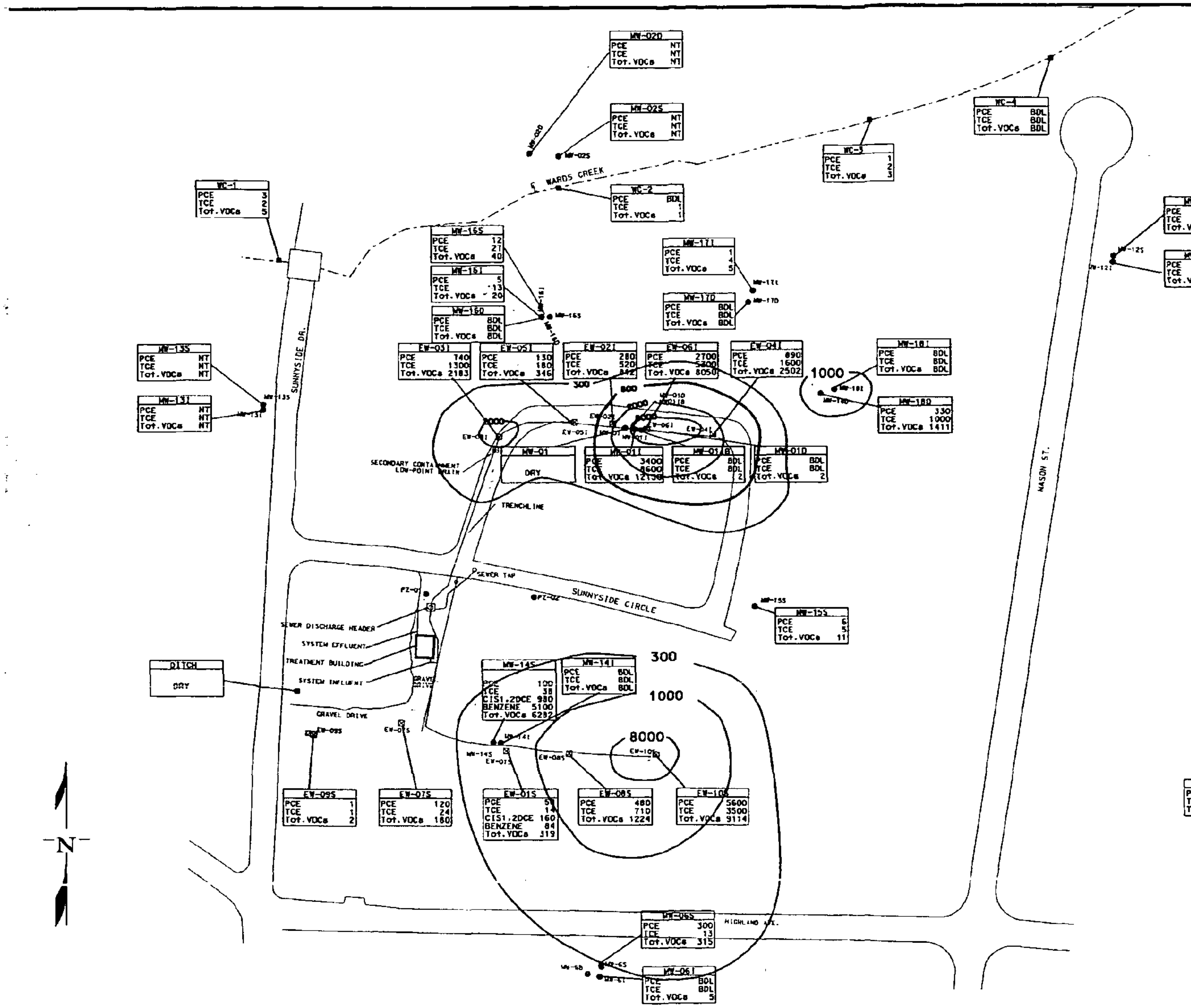
ENGINEER	SS	DRAWN	AHW
CHECKED	EH	DATE	05/28/02

SITE LAYOUT
ELMORE WASTE DISPOSAL SITE
GREER, SOUTH CAROLINA

FIGURE 3 1

40000-46110/46104/CADD/SITE LAYOUT

CAD DWG NO.: CF0003357
FIGURE 2
ACAD
1=1
5/02/02



NOTES

(1) Shallow extraction well screens are 30 ft long and collect water at depths from 20 ft to 50 ft below ground surface.

(2) Intermediate extraction well screens are 30 ft long and collect water at depths from 50 ft to 80 ft below ground surface

(3) MW-18D is 120 ft deep and collects water from 110 ft to 120 ft below ground surface

(4) The plumes represent VOC concentrations from three different horizons, therefore, they appear disconnected.

LEGEND

- ---- Ward's Creek
- ● Monitoring Well
- ▪ Surface Water Sampling Location
- ⊠ Extraction Well
- BDL Below Method Detection Limit
- J Estimated Value
- NT Not Tested
- 500 Concentration Contour

Well Number	
PCE	1000
TCE	2000
Tot. VOCs	3000

Numbers are concentrations in ppb.

GRAPHIC SCALE

PLUME MAP FOR THE THIRD QUARTER 2002 SAMPLING EVENT
ELMORE WASTE DISPOSAL SITE, GREER, SOUTH CAROLINA

FIGURE 3-2

Table 3-2

Historical Monitoring and Extraction Well Analytical Summary

Elmore Waste Site, Greer, SC

Monitoring Wells

	MW-01IB					MW-01I					MW-01D					MW-02S					MW-02D				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)	10	9	10	5	BDL	1700	1300	1600	1700	3400	7	7	4	5	0	-	-	-	BDL	-				BDL	-
TCE (ug/L)	9	9	6	4	BDL	3000	3300	2700	3600	8600	6	6	3	4	0	-	-	-	BDL	-				BDL	-
Total VOCs (ug/L)	22	20	19	12	2	4746	4657	4300	5349	12130	16	16	9	11	2	-	-	-	BDL	-				1	-

	MW-06S					MW-06I					MW-12S					MW-12I					MW-13S				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)	470	360	350	250	300	4	4	3	3	BDL	-	-	-	BDL	-	-	-	-	BDL	-	-	-	-	BDL	-
TCE (ug/L)	31	25	16	15	13	4	2	1	2	BDL	-	-	-	BDL	-	-	-	-	BDL	-	-	-	-	BDL	-
Total VOCs (ug/L)	501	385	366	265	315	13	12	8	10	5	-	-	-	BDL	-	-	-	-	1	-	-	-	-	BDL	-

	MW-13I					MW-14S***					MW-14I					MW-15S					MW-16S				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)	-	-	-	BDL	-	87	110	90	63	100	BDL	BDL	BDL	BDL	BDL					6				9	12
TCE (ug/L)	-	-	-	BDL	-	32	40	31	25	38	BDL	BDL	BDL	BDL	BDL					5				20	27
Total VOCs (ug/L)	-	-	-	27	-	3259	4469	4993	2922	6282	BDL	1	BDL	BDL	BDL					11				31	40

	MW-16I					MW-16D					MW-17I					MW-17D					MW-18I				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)				6	5				BDL	BDL				BDL	1				BDL	BDL				BDL	BDL
TCE (ug/L)				14	13				BDL	BDL				BDL	4				BDL	BDL				BDL	BDL
Total VOCs (ug/L)				25	20				1	BDL				2	5				1	BDL				1	BDL

	MW-18D				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)				220	330
TCE (ug/L)				660	1000
Total VOCs (ug/L)				932	1411

Extraction Wells

	EW-01S					EW-02I					EW-03I					EW-04I					EW-05I				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)	68	68	59	45	58	290	220	330	180	280	270	820	730	740	740	440	890	680	800	890	200	260	120	240	130
TCE (ug/L)	21	17	16	12	14	600	480	650	300	520	530	1500	1300	1100	1300	680	1600	990	1200	1600	310	430	180	320	180
Total VOCs (ug/L)	366	386	428	417	319	925	733	993	496	812	1089	2509	2175	1987	2183	1135	2503	1681	2000	2502	755	777	337	630	346

	EW-06I					EW-07S					EW-08S					EW-09 Spring Sump					EW-10S				
Parameter	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02	Sep-01	Dec-01	Mar-02	Jun-02	Sep-02
PCE (ug/L)	350	1900	1400	1900	2700	86	120	100	130	120	640	870	760	990	480	8	4	4	4	1	3800	5300	5700	5700	5600
TCE (ug/L)	210	4300	2200	3200	5300	24	26	26	28	24	440	750	550	640	710	14	9	6	6	1	2300	3100	2700	3200	3500
Total VOCs (ug/L)	584	6257	3600	5100	8050	156	192	172	216	180	1152	1684	1350	1655	1224	39	24	15	15	2	6138	8438	8400	8900	9114

Notes:

	Shading indicates heavily contaminated well (Total VOCs above 1000 ug/l).
-	Dash indicates sampling performed only on an annual basis (in June), not quarterly.
BDL	Below detection limits.
DNA	Data not available.

*** MW-14S Total VOCs include high levels of Benzene and cis-1,2-DCE. (see Section 4.4 in the text).

MW-16S had slightly higher VOC detections (31-40 ug/L VOCs), which indicates minor VOC migration past the northern line of extraction wells in the north-central site area. These results are consistent with VOC detections observed in Wards Creek, which is discussed further in Sections 3.3 and 3.6.

EW-09, which was installed in the Spring Sump, had minor VOC detections (2-15 ug/L VOCs) consistent with historical Spring Sump sampling results. The EW-09 location represents the western limit of the shallow aquifer plume on the south end of the site. The two new piezometers were not sampled for laboratory analysis during this work effort. Sampling the piezometers, however, is recommended and was performed during November 2002. Data from the November sampling of the piezometers will be incorporated into the final revision of this document.

3.1.2 Intermediate Wells

Three intermediate monitoring wells (MW-16I, MW-17I, and MW-18I) were installed down gradient of the existing northern extraction well line. As indicated on Table 3-2 and in Figure 3-2, low part per billion VOCs (20-25 ug/L VOCs) were present at MW-16I, with lower VOC levels (2-5 ug/L VOCs) at MW-17I, and only trace detections (1 ug/L VOC) at the MW-18I. Low level VOCs at these down gradient locations may be attributable to incomplete capture from extraction wells or low level residual soil contamination in the area.

3.1.3 Deep Wells

Four deep monitoring wells (MW-02D, MW-16D, MW-17D, and MW-18D) were installed down gradient and partially side gradient (MW-18D) of the existing northern extraction well line. As indicated on Table 3-2 and in Figure 3-2, no site related VOCs were present at MW-02D, MW-16D, and MW-17D; however, elevated VOC levels (932-1,411 ug/L VOCs) were present at the MW-18D. This data indicates that, at the locations tested, little or no contaminant migration to the deep aquifer is occurring north of the main plume. The absence of contamination in MW-02D supports the likelihood that no contaminants have migrated north of Wards Creek. Elevated VOCs in MW-18D, however, do indicate contaminant migration to the deep aquifer northeast of the main plume.

3.2 Indoor Air Sampling/Soil Gas Survey

Indoor air sampling was not performed during the recent field investigation. Past indoor air sampling has not found measurable concentrations of site contaminants. Soil gas sampling, however, was performed in the central portion of the site; an area that historically has had the highest VOC levels in groundwater. The rationale for this soil gas sampling was based on the premise that if no VOC contamination existed in surface soils, then it is likely that onsite residences would not have a problem.

EPA collected soil gas samples at 11 locations across the site in Summer 2002 and used sampling results to determine whether indoor air sampling of residents' homes was warranted. Soil gas sampling analytical results indicated the presence of 6 of the 11 VOCs detected in previous groundwater samples. Tetrachloroethylene was the most prevalent COC, being detected in 9 of the 11 sampling locations. Tetrachloroethylene was highest at sampling location SG-01A (near extraction well EW-10) with a concentration of 2,400 ug/M^3. Trichloroethylene was also highest in sampling location SG-01A, with a concentration of 54 ug/M^3. Please note that the highest concentrations of total volatile organic compounds were detected at EW-10. A copy of the EPA's Soil Gas Survey is included in Appendix A.

Based on the results of the soil gas study, EPA subsequently performed a human health risk-based screening of the COCs from the study. EPA issued a memorandum dated November 20, 2002, presenting the findings from the risk-based screening, a copy of which is included in this report as Appendix B. The memo concludes that soil gas samples exceed risk-based screening values for human receptors for chloroform, benzene, tetrachloroethylene, and trichloroethylene. Since the screening values were exceeded, the memo recommended sampling/monitoring of the air in the crawl space and lowest living areas of houses in the subject area. Modeling to estimate vapor intrusion into site homes was also suggested. The EPA RPM has indicated the EPA intends to perform the recommended air monitoring in the near future (January 2003).

3.3 Additional Surface Water Sampling

The RSE team recommended additional surface water sampling at points along the 400 to 600-foot section of Wards Creek, bordering the site to the north, to assess the site's impact on the creek. This recommendation was based on the premise that contaminants could enter the creek between the two historical upstream and downstream sampling points and volatilize before reaching the downstream sampling point.

Beginning in the first quarter of 2001, two additional surface water sampling locations (designated WC-2 and WC-3) were added to the quarterly sampling program. Each quarter since then, four surface water samples have been collected and analyzed for VOCs. The four sample locations and the September 2002 analytical results are indicated on Figure 3-2. Table 3-3 presents a historical summary of analytical data from Ward's Creek. Analytical results indicate the presence of low part-per-billion level VOCs at the new, centrally located sampling points at slightly higher concentrations than the upstream and downstream locations. Creek water samples at the central locations have VOC concentrations in the 0 to 15 ug/L range.

The centrally located surface water VOC detections suggest that VOCs likely are migrating from the site into the creek, but the steady creek flow and the natural volatilization process cause VOCs to drop below cleanup levels after traveling short distances downstream. However, samples collected from the downstream location between April 1998 and March 2000 were above cleanup levels. Since that time, VOC levels at the downstream location have trended steadily downward, as reflected in the Quarterly Reports for the Elmore site. Extraction wells, which began pumping in 1999, could account for the positive impact on the creek. The RSE team recommended continued quarterly sampling at the four surface water locations in Wards Creek and also collection of a surface water sample from a roadside ditch near EW-09S to test for the presence of site contaminants. To date, analytical results from EW-09S has been below cleanup levels.

3.4 Discharge of Untreated Water to Sewer System

The RSE team, as well as EPA/BVSPC personnel, recognize the treatment system influent concentrations are approaching the permitted City of Greer DMR limit of 2.13 mg/l for Total Toxic Organics (TTO). The RSE team recommended that the City of Greer be requested to approve a slight increase in the discharge limit so that it would be possible to discharge water without treatment. Although a limit increase has not been formally requested, discharge of only filtered water to the sewer system began in October 2001, when the treatment system granular activated carbon (GAC) beds were exhausted. Water continues to be processed through bag filters and carbon vessels, and each month influent and effluent water samples are collected for VOC analysis. Analytical results show the effluent sample has not exceeded the DMR limit; therefore, no activated carbon replacement is planned. The City of Greer was consulted about continued operation with spent GAC, and they did not offer opposition as long as the discharge criteria is met.

3.5 DMR Revision to Eliminate Pesticide and SVOC Analysis

In February 2001, the project team completed a system optimization activity to eliminate pesticides, metals, and SVOC analysis from the discharge monitoring requirements. Pesticides, metals, and SVOCs have consistently been absent in sample analyses, and the compounds were not contaminants of concern at the site.

Table 3-3
Summary of Historical Surface Water Analytical Data Along Wards Creek, Elmore Waste Disposal Site

Sample Location ID	Contaminant of Concern	1stQtr98	2ndQtr98	3rdQtr98	4thQtr 98	1stQtr99	3rdQtr99	4thQtr 99	1stQtr00	2ndQtr00	3rdQtr00	4thQtr 00
		(ug / L)										
WC1	PCE							1	2	0	0	0.65
	TCE							0	2	0	0	0
WC2	PCE											
	TCE											
WC3	PCE											
	TCE											
WC4	PCE	6.32	6.41	6.07	5.81	5	1	5	4	2	0	1.5
	TCE	15.3	25.2	16.9	13.5	6.5	3	11	9	4	1	2.7

Sample Location ID	Contaminant of Concern	1stQtr01	2ndQtr01	3rdQtr01	4thQtr 01	1stQtr02	2ndQtr02	3rdQtr02	4thQtr 02
		(ug / L)							
WC1	PCE	2	1.2	1	1	0	0	3	
	TCE	0	0	0	0	0	0	2	
WC2	PCE	2	2.9	0	5	2	0	0	
	TCE	3	5.3	0	3	3	0	1	
WC3	PCE	6	2.5	2	5	3	1.3	1	
	TCE	14	4.8	4	7	5	2.3	2	
WC4	PCE	3	1.1	0	0	0	0	0	
	TCE	5	2.1	0	1	2	0.65	0	

Note:
WC1 Located near roadway bridge on Sunnyside Drive
WC2 Located approx. 250 ft. east of WC1 (Vicinity of MW-02 cluster)
WC3 Located approx. 300 ft. east of WC2
WC4 Located near cul-de-sac on Mason Street.
A blank cell indicates location not sampled

BVSPC requested that the City of Greer Commission of Public Works (CPW) revise DMR requirements to eliminate monthly testing for copper, lead, and quarterly testing for Total Toxic Organics (TTO), which include pesticides and SVOCs. In April 2001, the CPW made the following DMR revisions (Figure 3-3 is a copy of the revised DMR):

- Monitor and report VOCs quarterly.
- Report TTO, copper, lead, and pH annually.
- Discontinue monitoring for BOD, COD, or TSS.
- Report maximum daily flow quarterly.

Figure 3-3

Revised Discharge Monitoring Report (DMR) Permit

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if different)
NAME Black & Veatch Special Project Corp.
ADDRESS 400 Northridge Road
Suite 350
Atlanta, GA 30350
FACILITY Elmore Site
LOCATION Sunnyside Circle, Greer

DISCHARGE MONITORING REPORT (DMR)

013-03-NCI
PERMIT NUMBER

MONITORING PERIOD
FROM YEAR MONTH DAY TIME TO YEAR MONTH DAY TIME

COMMISSION OF PUBLIC WORKS
P.O. BOX 216
GREER, SOUTH CAROLINA 29652

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS		
Volatile Organic Compound: (VOC)	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT					M&R	M&R	Mg/1	1/90	GRAB
Total Toxic Organics (TTO)	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT						2.13	Mg/1	1/365	GRAB
Copper	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT	0.17	0.25	lbs/day		0.4	0.6	Mg/1	1/365	GRAB
Lead	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT	0.08	0.12	lbs/day		0.2	0.3	Mg/1	1/365	GRAB
pH	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT				5.0		9.0	S.U.	1/365	GRAB
Flow	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT		50,000	GPD						
	SAMPLE MEASUREMENT									
	PERMIT REQUIREMENT									

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

TYPED OR PRINTED

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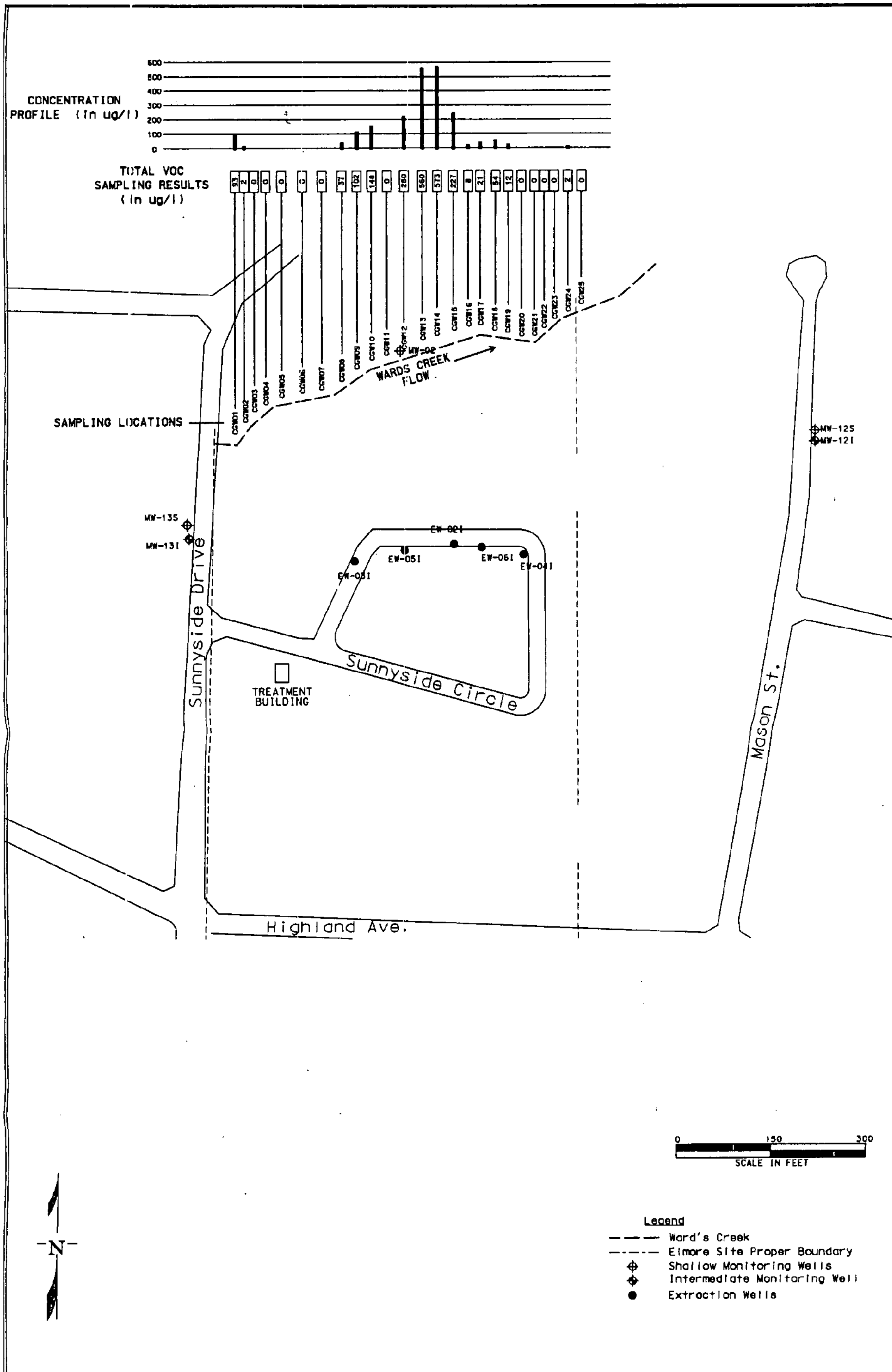

VOC RESULTS OF GROUNDWATER BENEATH WARDS CREEK, FIRST QUARTER 2002
ELMORE WASTE DISPOSAL SITE, GREER, SOUTH CAROLINA

Figure
3-4

4.0 Other Completed New Work

4.1 Capture Zone Analysis

The November 2002 Draft Capture Zone Analysis Report concludes that neither shallow extraction wells nor intermediate extraction wells are capturing the VOC plumes completely in their respective aquifers. VOC contamination in recently installed down gradient monitoring wells and Wards Creek validate this conclusion.

The report further indicates that a high degree of uncertainty exists in plume captures predicted by modeling because of limited site hydraulic conductivity data, suspected high variability in hydraulic conductivity across the site, and an insufficient monitoring well/piezometer network. The report concludes that to model plume capture accurately, additional slug tests and/or aquifer pumping tests are needed or more monitoring wells/piezometers should be installed to provide data to evaluate plume captures.

Accurate values for hydraulic conductivity distribution, combined with an evaluation of capture zones (modeling), will estimate where extraction wells are not capturing the plume. In addition, more accurate data will help determine the extraction rates needed to achieve capture. If the rates cannot be achieved by existing extraction wells, additional extraction wells could be located and installed to capture the plume. Lastly, the achievable extraction rate (yield) for EW-03 was deemed inadequate, and the report recommends replacing this well.

4.2 Extraction Well Production Goals

The November 2002 Draft Capture Zone Analysis Report estimates daily extraction rates needed to capture the contaminated plume completely, based on available hydraulic conductivity estimates. Several extraction wells cannot achieve these rates. The Capture Zone Analysis Report recommends obtaining additional information on hydraulic conductivity values and re-running the groundwater flow model to determine more appropriate extraction rates and identify deficiencies. If additional extraction wells are needed for complete plume capture, modeling can help to select optimum extraction well locations and extraction rates. In the interim, the operator has reset several well pumping levels in an effort to increase extraction rates. In addition, beginning in January 2003, weekly operation reports will present "Average Extraction Rates" for each extraction well as opposed to just presenting instantaneous extraction rates. The average rates can be readily compared to the production goals for each well and deficiencies more easily recognized.

4.3 In-Situ Biological Treatment Evaluation

The RSE Report discusses in-situ bioremediation using an organic substrate, such as hydrogen release compound (HRC) from Regenesis, along with other slow release substrates. In September 2002, Regenesis performed an evaluation of the Elmore site and recommended a pilot scale field test to determine feasibility and design parameters before full scale implementation. The pilot would consist of a line of 30 wells covering 150 feet. HRC would be injected into the wells, and the plume would be monitored as it migrates north.

Preliminary evaluation of the proposal indicates that the HRC process has been successful in degrading PCE/TCE to DCE; however, other in-situ conditions were necessary to continue the degradation from DCE to vinyl chloride (VC) and finally to ethylene. If degradation stopped at DCE, even though the project cleanup goal is higher for DCE than for PCE or TCE, DCE concentrations would still be above the goal and pumping would need to continue. Additionally, if degradation continues to VC in this residential setting, it could adversely affect health based risks around the site. Based on this potential risk, in-situ bioremediation is not recommended at this time. However, further evaluation of additional technologies and/or new and emerging technologies should be considered in the future to potentially accelerate site closure.

5.0 Conclusions

This report presents a summary of groundwater investigation work, groundwater modeling, capture zone analysis, soil gas surveys, and system optimization activities completed during 2002. The following conclusions can be drawn from the results of these activities and evaluation of the new data.

- The installation and sampling of 5 new shallow wells/piezometers, 3 new intermediate wells, and 4 new deep wells significantly improved the coverage of the monitoring well network at the site. The eastern edge of the shallow groundwater VOC plume has been defined by new well MW-15S. Total VOCs detected in this well was only 11 µg/L. New deep well, MW-02D, has demonstrated the plume has not migrated north of Wards Creek in the deep aquifer. New deep well MW-18D does, however, indicate contaminant migration to the deep aquifer northeast of the north extraction well line. MW-18D is screened at a depth of 110-120 feet, and had total VOC concentrations of 1,411 µg/L. The 3 new intermediate wells (MW-16I, MW-17I, and MW-18I) indicate only low part-per-billion VOCs migrating north of the extraction wells. The highest VOC levels of the three new intermediate wells are in MW-16I, with a total VOC concentration of 20 µg/L. This would suggest a relatively effective capture of COCs in the intermediate aquifer by the north extraction well line. However, the distance between the 3 new intermediate wells is approximately 200 feet, which means that COCs could be escaping between the wells and not be detected.

- The Capture Zone Analysis report suggests that contaminant plume capture <u>is not complete</u> in either the shallow or intermediate aquifers. Additional monitoring wells and/or piezometers and/or pumping tests would improve the accuracy of the modeling and analysis. The analysis also provided minimum extraction rates for each extraction well that is required to achieve capture based on best available estimates of aquifer hydraulic conductivity. However, based on 2.5 years of operations, many of the extraction wells are incapable of sustaining the required extraction rates to achieve the capture. This would indicate that additional extraction wells would be needed to achieve the desired capture, and additional monitoring wells/piezometers will be needed to monitor/confirm capture.

- A soil gas survey was conducted to determine if VOCs from site groundwater have migrated to the ground surface at concentrations that could potentially pose a human health risk to site residents. Soil gas samples were collected at 11 locations in the central portion of the site, as indicated on Figure 3-2.

  A human health risk-based screening was subsequently conducted by EPA using the results from the soil gas survey. Soil gas samples were found to exceed risk-based screening values for human receptors for chloroform, benzene, tetrachloroethylene, and trichloroethylene.

- The quarterly surface water sampling of additional locations in Wards Creek, in conjunction with the pore water sampling beneath Wards Creek, confirms that VOC migration into the creek is occurring along approximately 250 feet of the creek at levels ranging from 8 µg/L to 573 µg/L total VOCs. The highest levels of VOC migration is occurring at the central portion of the site due north of the north extraction well line in the approximate vicinity of the MW-02 cluster. This data confirms that plume capture by the extraction wells is incomplete. However, based on the absence of VOCs in MW-02S/MW-02D and no detections from any of the isolated zone packer tests performed during the recent drilling of MW-02D, VOC migration does not appear to extend beyond Wards Creek to the north.

- Wards Creek historical surface water analytical data shows the levels of VOCs present in the creek water has been relatively low (non-detects to a maximum 25 - 35 µg/L total VOCs) and has steadily decreased since the pump and treat system has been in operation. In addition, an abundance of wildlife (crawfish, minnows, salamanders) in the creek indicates a generally healthy condition. However, low COC levels and healthy conditions may be more the result of continuous base flow of the creek (see pore water sampling bullet below).

- Pore water sampling of the creek bed indicated that elevated levels of VOCs (maximum 573 µg/L) are entering the creek, primarily in the central area of the creek in the vicinity of the MW-02 well cluster. Low creek surface water VOC concentrations are likely the result of rapid dilution and volatilization once the VOCs enter the creek water. This new data is a clear indication that plume capture is incomplete, although the exact migration path and source aquifer depth from the site is still uncertain.

- The VOC levels in the system influent have remained at or below the permitted discharge limit of 2.13 mg/L TTO for the past 9-12 months. This has enabled operation of the treatment/discharge system without the necessity of replacing the 3 spent GAC filters, thereby reducing operating costs. If additional extraction wells are installed, however, the possibility exists that influent VOC levels may again rise above the 2.13 mg/L TTO level. Should this occur, carbon replacement will be recommended/necessary.

- Requested and approved reductions in the effluent monitoring frequency and list of parameters have been in effect for over one year and have reduced operating costs.

- Resampling of 9 of 12 old monitoring wells on the original Elmore Waste Disposal site was performed, and minor detections of VOCs were still observed in some of the wells. No further sampling of these wells is planned during 2003.

- A preliminary evaluation of in-situ biologic technology (Regenesis HRC injection) to potentially accelerate groundwater cleanup did not appear promising due to uncertainty in achieving cleanup criteria and the likely formation of vinyl chloride which poses greater adverse health risks.

6.0 Recommendations

The following recommendations are made based on the results of the current work effort, 2½ years of site and operations knowledge of the Elmore site, and experience from other sites.

- Install a new intermediate depth extraction well ± 40 feet northeast of existing extraction well EW-03I. Continue to operate EW-03I in addition to the new well.

- Perform a pumping test on recently installed deep (120 feet) monitoring well MW-18D, which was found to have significant levels of VOCs (1,411 µg/L TVOCs). The objective of the test will be to measure the hydraulic conductivity and determine whether the well is suitable for conversion to an extraction well.

- Either convert MW-18D (2-inch well screened from 110 feet - 120 feet) to an extraction well, or install a new 6-inch extraction well in the vicinity, screened across the same fracture zone as MW-18D. Data from the pumping test recommended above should be evaluated to determine if the 2-inch well (MW-18D) can meet the optimal production rate. Property access may also contribute to this decision.

- Install 6 to 7 additional piezometers that can be used to directly measure actual capture zones created by existing extraction wells.

- Install 2 to 4 shallow monitoring wells along the south side of Wards Creek in an effort to better define the VOC migration pathway to the creek and to monitor for changes in VOC levels in groundwater discharging into the creek.

- Perform the indoor air sampling study to determine if site contaminants pose a risk to local residents.

Appendix 6
Quarterly Groundwater Monitoring Report, 1st Quarter 2003 (Black & Veatch)

U.S. Environmental Protection Agency

EPA Region 4

RESPONSE ACTION CONTRACT

Contract No. 68-W-99-043

1st QUARTER 2003 REPORT
For The
GROUNDWATER PUMP and TREAT SYSTEM
Elmore Waste Disposal Superfund Site
Greer, Spartanburg County, South Carolina

BLACK & VEATCH Special Projects Corp.

1st QUARTER 2003 REPORT
For The
GROUNDWATER PUMP AND TREAT SYSTEM

JANUARY 1, 2003 to MARCH 31, 2003

Elmore Waste Disposal Superfund Site
Greer, Spartanburg County, South Carolina

Prepared Under
EPA CONTRACT NO. 68-W-99-043
RACS WORK ASSIGNMENT NO. 004-RARA-04N3

For the
WASTE MANAGEMENT DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

Prepared by

BVSPC Special Projects Corp.
Atlanta, Georgia

BVSPC Project No. 48104.141

May 2003

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Acronyms

BNA	Base, Neutral, and Acid Extractable Compounds (Semi-Volatiles)
BOD	Biological Oxygen Demand
B&V	Black and Veatch
BVSPC	Black and Veatch Special Projects Corp.
COD	Chemical Oxygen Demand
CPW	Commission of Public Works
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
EW	Extraction Well
GPM	Gallons Per Minute
MW	Monitoring Well
O&M	Operations and Maintenance
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene or Perchloroethene
PLC	Programmable Logic Controller
RAC	Response Action Contract
SCDHEC	South Carolina Department of Health and Environmental Control
SOW	Statement of Work
TCE	Trichloroethene
TCLP	Toxic Characteristic Leachate Procedure
TOC	Top of Casing
TSS	Total Suspended Solids
TTO	Total Toxic Organics
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compounds
WA	Work Assignment

1.0 Introduction

1.1 Scope

Black and Veatch Special Projects Corp. (BVSPC) has been tasked by the United States Environmental Protection Agency (EPA), to conduct Operations and Maintenance (O&M) at the Elmore Waste Disposal Groundwater Extraction and Treatment Facility, located in Greer, Spartanburg County, South Carolina. This 1st Quarter 2003 Report is responsive to the RAC IV Contract No. 68-W-99-043, work assignment (WA) No. 004-RARA-04N3, Statement of Work (SOW), dated July 8, 1999.

1.2 Purpose

The purpose of this quarterly report is to document and describe operational and monitoring activities related to the groundwater extraction and treatment system at the Elmore Waste Disposal Site in the past 1st Quarter of 2003. Included in the quarterly report are:

- descriptions of operations, problems encountered, and repairs performed,
- quarterly photos,
- volumes of water discharged,
- a process flow diagram,
- site maps,
- monthly analytical results for system influent and effluent monitoring,
- quarterly sampling and analysis results,
- a groundwater potentiometric map,
- plume map,
- estimates of contaminant mass removed from each extraction well, and
- recommendations.

1.3 General

The 1st Quarter period is defined as January 1, 2003 through March 31, 2003. Black & Veatch performed the quarterly sampling event in February 2003 which included collection of water samples from extraction wells, monitoring wells, piezometers, the treatment system, and surface water from nearby Wards Creek.

2.0 System Operations

System operating information is collected by a combination of electronic data logging in the Programmable Logic Controller (PLC) unit and manual record keeping. The PLC control system information is automatically faxed to the local operator each day by the control system and analyzed to ensure the facility is in service. This information is filed at the local operator's office and includes electronic records of individual extraction well pumping rates, water levels, and alarm conditions.

Appendix A contains lab analytical results of the quarterly sampling event conducted this quarter. The quarterly Discharge Monitoring Report (DMR) for the City of Greer, SC is presented in **Appendix B**. In addition, following the conclusion of each month a Monthly Operations Report is prepared documenting work performed on-site, problems noted, corrective actions taken, flow measurements, photos, etc. Copies of these Monthly Operations Reports for the quarter are presented in **Appendix C**. In **Appendix D** resides the report of the annual well inspection performed in January.

2.1 Summary of Quarterly System Operations

Over 27 million gallons of groundwater have been treated to date by the remediation system with more than 2 million gallons treated this quarter (see **Tables 3-1** and **3-2**). Overall the system performed well this quarter with only minor interruptions requiring operator intervention.

The Annual Well Inspection event occurred at the site in January. Pumps, flowmeters, transducers, etc were cleaned and inspected (see **Photo 1**). No major problems were noted. Transducers are recording accurate water levels. Two wells had broken suspension cables and were repaired. Minor leaks from pipe fittings in 2 well vaults were sealed. The Well Inspection Report containing notes and diagrams is located in **Appendix D**.

The ProControl PLC System required attention this quarter. A faulty flowmeter at EW-09 caused a drain of the 24V power supply in January. This drained the UPS system and caused a shutdown of both Control Systems A&B. After isolating a faulty wire, further troubleshooting indicated a weak UPS unit, unable to hold a full charge after recharging overnight. A new UPS was installed in the control panel (see **Photos 2&3**). Troubleshooting the flow meter at EW-09 was again required in February. The spare flow meter was installed to replace the existing one. After extensive troubleshooting, another shorted wire was isolated inside the well vault. It was cut away and cables respliced (see **Photo 4**). The well was then successfully restarted in automatic mode on 2/28. However, heavy rains in March caused a rise in the groundwater table and consequently flooded the EW-09 vault. With the flowmeter underwater, volume and flow were not being recorded. The well is turned off temporarily until the water table drops again. A new waterproof flowmeter will be installed in this well next quarter.

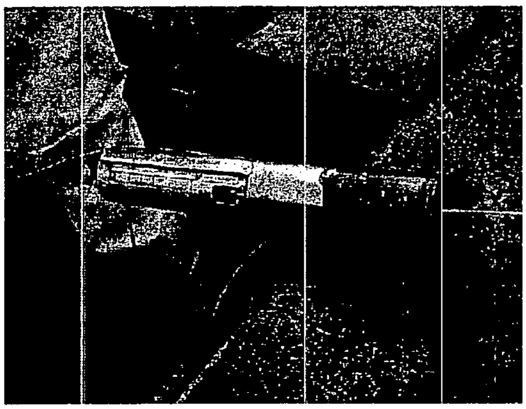


Photo 1: Pump pulled for inspection.

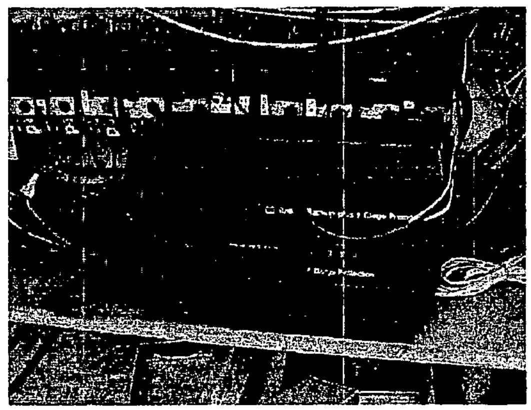


Photo 2: New UPS Battery Backup.

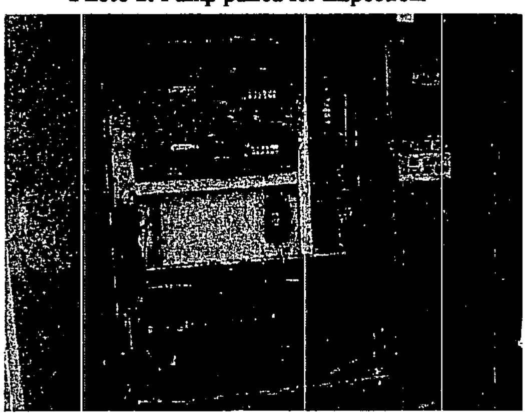


Photo 3: New UPS, not yet mounted in Panel.

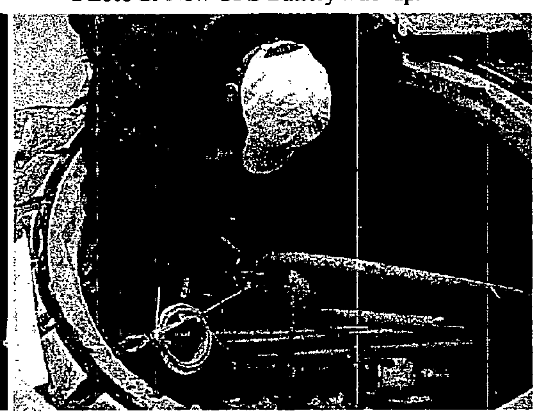


Photo 4: Troubleshooting Wiring to EW-09 Flowmeter.

The pump on-off set points on 4 extraction wells were lowered this quarter in an effort to maximize their groundwater extraction rates and increase their groundwater capture zones as recommended in the Capture Zone Analysis Report. Wells include EW-01, EW-04, EW-05, and EW-06. Well extraction rates will be monitored and adjusted periodically to improve their capture zones.

Quarterly sampling for the 1st Quarter 2003 was conducted in February (see **Photo 5**). Thirty-five water samples were collected from the extraction wells, monitoring wells, treatment system, and surface waters for VOC analysis. In addition, Influent and Effluent volumes were collected for analysis of BNAs and Pesticides/PCBs as required annually for the DMR permit. Sampling results are discussed in detail in **Section 4.0** and the lab analytical data from this sampling effort is included in **Appendix A**.

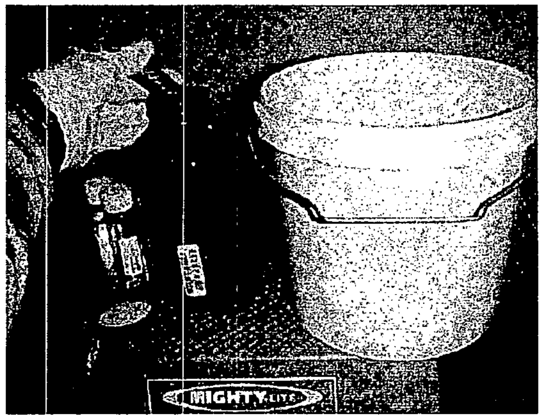


Photo 5: BNA Sample Collection.

Regularly scheduled preventive maintenance was conducted each month during the quarter. Activities include backwashing Carbon Vessel #1, changing bag filters, recording pump amps, cleaning the float switch in the EQ tank, inspecting drying tubes, and general housekeeping and system checks. Water is also removed from the low-point drain each month and transferred to the Equalization Tank for treatment. As a matter of record, 30 gallons were removed from the low point drain in January and 15 gallons in February. The low point drain is scheduled to be pumped out again the first week of April. The heater temperature setting inside the Treatment Building was lowered from 60^{O}F to 56^{O}F as a cost savings measure (see **Photo 6**). Several flow meters required cleaning in March to enable the meters to sense flow and accumulate total flow readings (see **Photos 7**).

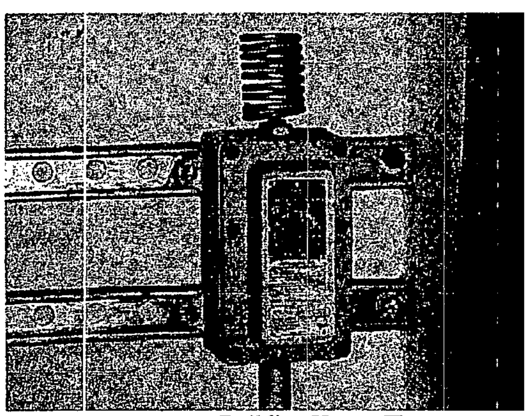


Photo 6: Treatment Building Heater Thermostat.

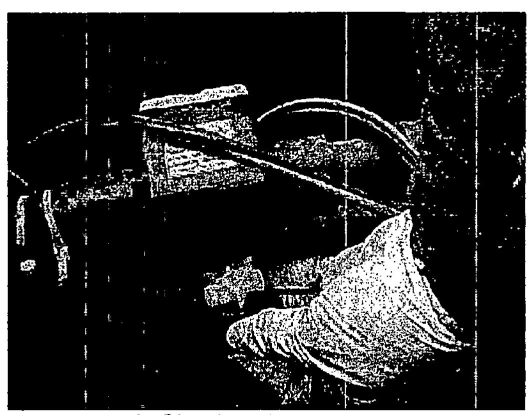


Photo 7: Cleaning Flow Meter.

EPA surveyed the top of casing (TOC) elevation of MW-15S on 3/12. The elevation had previously been estimated but was determined to be 941.93 ft.

Influent and Effluent water samples are collected monthly to ensure permitted discharge limits are not being exceeded by the effluent water flowing into the local sewer system. Total Toxic Organics (TTO) lab analytical results have historically remained below the City discharge permit limits of 2,130 ug/l even though the activated carbon is exhausted of treatment capacity. Monthly Influent and Effluent water samples were collected on 1/28, 2/17 and 3/18 for analysis of VOCs. These results have verified permitted TTO discharge limits are not being exceeded (refer to **Table 4-1b**). Should limits be exceeded, activated carbon replacement will be required.

A neighborhood meeting was conducted by EPA on 2/20 to discuss upcoming air testing events with the nearby residents. An air monitoring/sampling event is planned for next quarter to determine the potential of contaminated vapor entering homes from the underground contaminated plume in the groundwater (see *Public Meeting Notice*, **Figure 2-1**). Additionally, the local newspaper reported the upcoming air sampling event planned by EPA. The news article is attached as **Figure 2-2** and is also at the end of this Section.

The *Remediation System Optimization (RSO) Report* was issued by B&V in January 2003 in response to the new wells installed in 2002, new sampling results of air and water media, and the recent Capture Zone study. It made several recommendations including:

- Installing several additional piezometers at the site to directly measure capture zones of existing extraction wells.
- Perform a pump test on MW-18D to determine whether the well is suitable for conversion to an extraction well.
- Perform indoor air sampling to determine whether site contaminants pose a potential health risk to local residents.
- Install a new extraction well near MW-03I because the existing well only produces a low volume of water each day.

Some of these recommendations are planned for implementation next quarter.

Availability Session/ Neighborhood Meeting

Thursday, Feb. 20, 2003
7:00 p.m.

Mr. Darryl Grady's
Activity Building
Sunnyside Drive at
Sunnyside Circle
Greer, South Carolina

Since 1998, the U.S. Environmental Protection Agency (EPA) has been implementing a groundwater cleanup project for the Elmore Waste Disposal Superfund Site in Greer, South Carolina. The cleanup operation uses a 10-well pump-and-treat system located in the Sunnyside Circle neighborhood. EPA is the lead agency for this work under Superfund, and the the South Carolina Department of Health and Environmental Control (SCDHEC) is the support agency.

During 2002, a variety of work was conducted by EPA and its cleanup contractor as part of a "system improvement" task. An Availability Session/Neighborhood Meeting was held on Feb. 5, 2002, to discuss plans for these activities and to update residents on the progress of the groundwater cleanup.

As EPA stated at that meeting, one of the planned tasks was to investigate the possibility that air-borne contamination in vapor form, coming up from the groundwater underlying the Sunnyside neighborhood, might be present in ambient air within homes. (This potential problem was investigated in 1994, with negative results.) To investigate this, soil gas sampling (sampling of air present in the ground), from 12 temporary well-points installed in the neighborhood, was conducted in May 2002.

The laboratory results, which became available in August 2002, do not indicate any immediate threat to health. The results were then compared to long-term health-risk standards using worst-case assumptions, in order to consider whether such risks could be present. Results of this comparison indicate that it is *possible* there could be potential long-term health risks. EPA believes that further, definitive sampling of home crawl spaces in the neighborhood is needed.

In many instances there are mitigating factors that prevent vapors from entering homes, including whether the home is built on a slab or has a crawl space, the degree of house and crawl space ventilation, climate, and others.

At this meeting, the EPA Project Manager will discuss the reasons for sampling crawl spaces under homes in the neighborhood, and the possible outcomes of this work. US EPA is responsible for the Site cleanup work, including any protective measures that may prove to be required to eliminate potential risks.

Residents who cannot attend this meeting are encouraged to call the Project Manager (see below) to schedule a time for a brief meeting with EPA. Each resident will be contacted in person before any sampling is done at each property.

FOR MORE INFORMATION

Please contact:

Stephanie Y. Brown
Community Involvement Coordinator
OR
Ralph O. Howard, Jr.
Remedial Project Manager

1-800-435-9233

Figure 2-1: Public Meeting Notice

2B greenvilleonline.com   WEDNESDAY, FEBRUARY 26, 2003 ■ THE GREENVILLE NEWS

State to test air in Greer residences

EPA had removed contaminated soil from the sites

By Angelia Davis
STAFF WRITER
adavis@greenvillenews.com

GREER — Federal environmental regulators will conduct tests to determine whether underlying contaminated groundwater is affecting air inside 20 Greer homes.

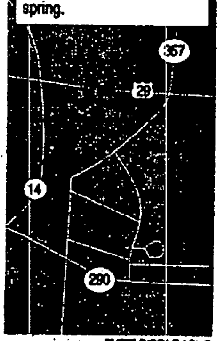
Ralph Howard Jr., remedial project manager for EPA, said the agency will collect air samples in the crawl space underneath the homes as part of its monitoring of groundwater around the Elmore Waste Disposal Superfund site near State 290 and Sunnyside Drive.

But some residents in the Sunnyside neighborhood question why the U.S. Environmental Protection Agency didn't do such testing underneath their homes in 1994, when it removed contaminated soil.

Resident Timmy Cooper said he recalls residents telling EPA then that more testing needed to be done underneath the homes.

"We should have had people look into it last time. This is one of the things we were afraid of," said Cooper, a member of the area's Community In Action group.

Air samples
Representatives from the U.S. Environmental Protection Agency are expected to begin collecting air samples from beneath 20 homes in the Sunnyside area in Greer this spring.



SUZIE RIDDLE / Staff

Howard said the new tests will be done because of concerns expressed to the agency that soil wasn't dug out from under crawl spaces in 1994, and some people feared they could be affected. But the cleanup done then and the tests that will be done in March or April aren't connected, he said.

He said the soil removal in 1994 was to address contaminated soil left from operations on the old Sunnyside dump. Some crawl space sampling also was done, but it was intended to look for problems related to groundwater.

He said the state of knowledge about groundwater and the vapors years ago wouldn't have led EPA and private science to consider or find it necessary to conduct the type of tests that are planned for this spring.

The Elmore site was used to store industrial waste oils in containers from 1975 until 1986.

Some barrels leaked, contaminating the soil and groundwater, primarily with trichlorethylene (TCE) and tetrachloroethylene (PERC). The contamination slowly flowed from the Elmore hazardous waste site and under the Sunnyside neighborhood and into Wards Creek, health officials have said.

Kevin Koporec, an EPA toxicologist, said the biggest health concern from the two contaminants is cancer, "assuming someone is going to be exposed for 30, 50, 70 years or so."

Howard said the goal of the soil removal in Sunnyside was to remove surface soil laden with lead, so residents would have clean soil for safe use in their yards.

EPA has been involved in cleaning groundwater there since 1998. Howard said it costs an average of $140,000 a year to operate the pump and treat the groundwater system.

In 2002, the agency tested samples of soil gas taken from 11 temporary vapor wells in Sunnyside to determine whether airborne contamination could come up from underlying groundwater and exist in air within the homes.

Some of the air samples showed numbers of the same chemicals that are in the groundwater. And in some, the amounts were in higher numbers than risk assessors say is definitely safe, Howard said.

However, he said, none of the levels represent an immediate health threat.

Howard said the groundwater beneath the homes is contaminated but not to the same degree in different locations.

The upcoming air testing will take two to three days to complete. The agency could get results in four to six weeks, he said.

He said if problems are found, the agency likely will move to fix them by creating ventilation under the homes.

Figure 2-2: Greenville News Article.

3.0 System Flow Rates

Figure 3.1 below shows a Process Flow Diagram of the pump and treat system currently in place at the Elmore Waste Disposal site. Over *27 million gallons* of contaminated groundwater have been collected and treated by this system to date.

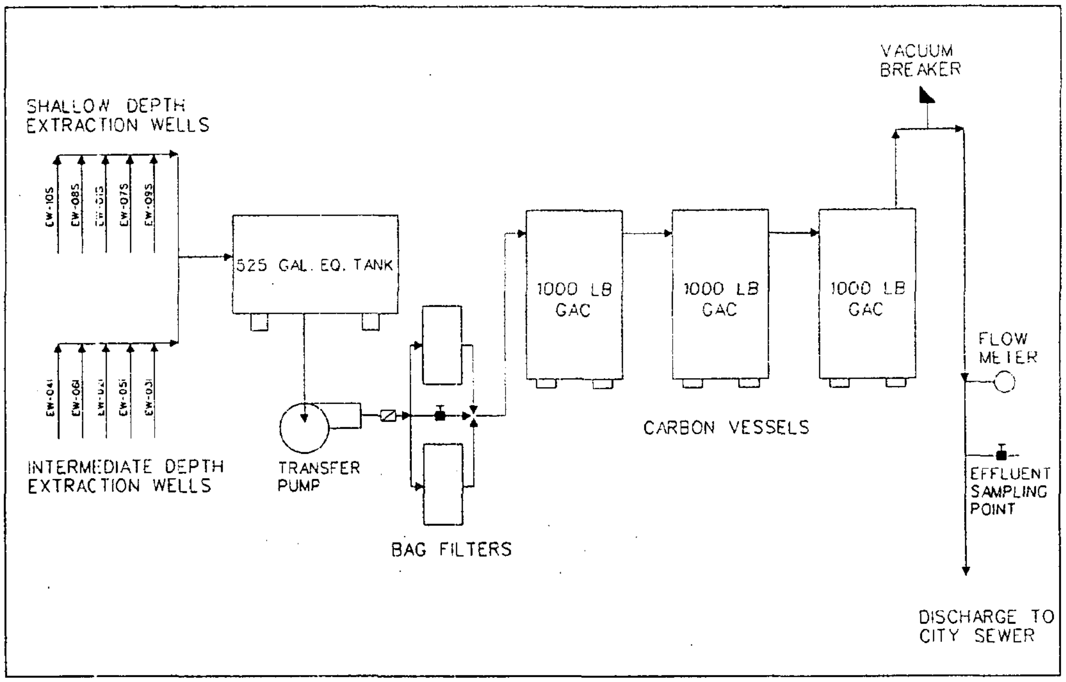


Figure 3-1 Process Flow Diagram

System flow rates are measured using a mechanical totalizing flow meter on the treatment system effluent line and by electronic pulse flow meters at each extraction well. These two sources of flow and quantities are discussed in the subsequent subsections.

3.1 Treatment System Flow Rates

Manual recording of the effluent totalizing flow meter was performed during each weekly visit throughout the quarterly period. Over *2.1 million gallons* of groundwater was processed during the quarter. This represents an average flow rate of slightly more than *24,000 gallons each day.* The following **Table 3-1** shows the total flow through the treatment system for the quarter and includes the previous 4 quarters for comparison. The increase in volume pumped is attributed to increasing the extraction rate at several wells to improve capture zones as recommended in the recent Capture Zone Analysis Report dated Novenber 2002.

Table 3-1

Quarterly System Flow

Month	Flow in Gallons
January 2003	710,100
February 2003	637,500
March 2003	822,000
1st Quarter 2003 Flow	**2,169,600**
Previous Quarters	
1st Quarter 2002 Flow	1,614,900
2nd Quarter 2002 Flow	1,251,900
3rd Quarter 2002 Flow	1,086,500
4th Quarter 2002 Flow	1,838,500

3.2 Extraction Well Flow Rates

The extraction well flow meter readings are totalized by the PLC unit and represent the flow totals for each individual well from the start of pumping. The following **Table 3-2** presents the quarterly totalized flows for each well beginning January 1, 2003 as well as cumulative flows since the system was installed. In addition, the treatment system readings from the effluent totalizer for the 4 previous quarters are presented for comparison.

As reflected in the table, EW-05 was the major water producer this quarter pumping an average of over 6,000 gallons per day. The volumes extracted from EW-02, EW-04, and EW-05 added together represent 60% of the total volume pumped this quarter.

Table 3-2
Extraction Well Flows

Extraction Well	1st Qtr 2003 Flow (gallons)	Cumulative Flow (gallons)
EW-01S	147,393	1,293,653
EW-02I	406,397	6,410,682
EW-03I	13,191	228,779
EW-04I	424,590	6,369,933
EW-05I	550,087	4,758,039
EW-06I	145,004	2,345,639
EW-07S	338,032	3,213,267
EW-08S	91,683	1,024,593
EW-09 (Spring Sump)	30,392	530,994
EW-10S	149,885	1,522,093
Total Well Flow from PLC	2,296,645	27,697,672
1st Qtr '03 System Flow from Mechanical Totalizer	2,169,600	27,289,800
Previous Quarters	*Quarterly Flow (gal)*	*Cumulative Flow (gal)*
1st Qtr '02 System Flow from Mechanical Totalizer	1,614,900	20,952,300
2nd Qtr '02 System Flow from Mechanical Totalizer	1,251,900	22,204,200
3rd Qtr '02 System Flow from Mechanical Totalizer	1,086,500	23,290,700
4th Qtr '02 System Flow from Mechanical Totalizer	1,838,500	25,129,200

These two independent sources of cumulative flow measurement shown this quarter are within 2% of each other, which indicates the data are substantially reliable and accurate.

4.0 Monitoring Results

During the quarterly sampling event in the 1st Quarter of 2003, a total of 35 water samples were collected for analysis. Samples of treatment system influent and effluent were analyzed for volatile organic compounds (VOCs). A sample was also collected from the discharge of Carbon Vessel Number 1 for VOC analysis. Samples from 15 monitoring wells, 2 piezometers, all 10 extraction wells, plus 4 surface water locations in Wards Creek and 1 from a roadside ditch were also collected and analyzed for VOCs. In addition, extra influent and effluent volume was collected to run analytical tests for BNAs, Pesticides, and PCBs this quarter as required annually by the City of Greer, Commission of Public Works (CPW) for the revised Discharge Monitoring Report (DMR).

4.1 Cleanup Criteria

The remediation goals specified in the Elmore Site Record of Decision, as amended by the January 1994 Explanation of Significant Differences, are listed below:

VOC	Remediation Goal (ug/l)
Benzene	5
Carbon Tetrachloride	5
Cis-1,2-Dichloroethene	70
Methylene Chloride	5
Tetrachloroethylene (PCE)	5
Trichloroethylene (TCE)	5
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
Vinyl Chloride	2

4.2 Treatment System Influent, Carbon Vessel 1 Discharge, and System Effluent Sampling Results

Treatment system influent, Carbon Vessel Number 1 discharge, and system effluent sampling during the 1st Quarter 2003 showed that quantities of contaminants are breaking through the carbon vessels and passing through to the city sewer. The total VOC concentration in the system influent was 1,152 ug/L. The total VOC concentration in the

Carbon Vessel Number 1 discharge sample and the concentrations in the effluent are 1,125 ug/L and 1,068 ug/L, respectively. These analytical results indicate the carbon vessels have exhausted their treatment capabilities. As shown in **Table 4-1a** below, the TCE contaminant concentrations are not being reduced as they pass through the carbon beds whereas PCE is decreasing slightly. This is potentially caused by bacterial action inside the carbon vessels preferentially consuming PCE while TCE passes through the treatment system unchanged and is seen in the effluent water. Alternately, the physical properties of the larger PCE molecule may still be attracted to the activated carbon whereas the smaller TCE molecule is not. Another possible explanation for the VOC levels appearing to fluctuate through the treatment system is VOC variation in the influent resulting from the cycling of the extraction wells.

Table 4-1a summarizes the analytical results for the untreated influent, Carbon Vessel #1 discharge, and system effluent samples. The previous quarterly sampling results are also listed for comparison.

Table 4-1a

Influent, Carbon Unit 1 Discharge, and Effluent Analytical Results

Parameter	4th Quarter 2002						1st Quarter 2003					
	Influent		Carbon 1		Effluent		Influent		Carbon 1		Effluent	
PCE (ug/l)	130		650		100	J	480		530		290	
TCE (ug/l)	370		820		1300		580	J	550	J	730	J
1,1-DCE (ug/l)	3	J	4	J	5	J	7	J	5	J	6	J
1,2-DCE (ug/l)	23		25		19	J	44		29		33	
Vinyl chloride(ug/l)	3	J	2	J	1	J	6	J	4	J	3	J
1,1,1-TCA (ug/l)	N.D.		N.D.		1	J	N.D.		1	J	1	J
1,1,2-TCA (ug/l)	N.D.		1	J	1	J	N.D.		N.D.		1	J
1,1-DCA (ug/l)	3	J	2	J	2	J	5	J	3	J	4	J
1,2-DCA (ug/l)	N.D.		N.D.		N.D.		N.D.		N.D.		N.D.	
Chloroform (ug/l)	N.D.		N.D.		N.D.		N.D.		N.D.		N.D.	
Benzene (ug/l)	13		2	J	N.D.		30		3	J	N.D.	
Total VOCs (ug/l)	545		1506		1429		1152		1125		1068	
Copper (mg/L)					NA						N.D.	
Lead (mg/L)					NA						N.D.	
TTO (mg/l)					NA						1.04	
pH, units					NA						5.50	

N.D. - Not Detected
J – Estimated Value
NA - Not Applicable

New activated carbon may be required in the near future should influent or effluent VOC concentrations increase above permitted Total Toxic Organics (TTO) limits for any reason. Currently there are no numerical limits on effluent VOC concentrations per the revised City of Greer DMR permit. The discharge limit on TTO is 2,130 ug/l which includes VOCs, BNAs, and Pesticides/PCBs. Historically, BNA and Pesticide/PCB sample results have been undetected. Monthly lab analytical results for TTO to-date show effluent concentrations remaining below the discharge permit limits. **Table 4-1b** below records the historical analytical results of the monthly influent and effluent sampling for the previous four months.

Table 4-1b

Monthly Influent & Effluent Analytical Results

To Verify Permit Discharge Limits

	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
	Dec 02		Jan 03		Feb 03		Mar 03	
PCE (ug/l)	360	150	620	160	480	290	520	390
TCE (ug/l)	420	830	830	560	580	730	490	620
Other (ug/l)	51	37	62	22	92	48	136	32
Total (ug/l)	**831**	**1017**	**1512**	**742**	**1152**	**1068**	**1146**	**1042**

Notes: 1. The City of Greer DMR limits TTO in effluent to 2,130 ug/l.

4.3 Contaminant Mass Extraction

4.3.1 Treatment System

Contaminant mass extraction was computed based on flow for the quarter from each individual well and contaminant concentrations at the wells for the four major contaminants (PCE, TCE, vinyl chloride, and benzene), all other VOCs, and total VOCs. These values were then added to the values computed through the end of the 4th Quarter 2003 to provide a cumulative mass extraction for each compound. **Table 4-2** below presents the total system contaminant mass extracted showing also the previous quarter for comparison. The slight decrease in pounds removed this Quarter is attributed to the slightly decreased groundwater contaminant concentrations in the most highly productive wells. This table is a summation of **Table 4-3** which details contaminant removal from each individual extraction well.

Table 4-2
Contaminant Mass Extracted

Compound	4th Quarter 2002		1st Quarter 2003	
	Lbs	Cum. Lbs	Lbs	Cum. Lbs
PCE	9.48	174.92	10.33	185.26
TCE	11.69	265.66	8.84	274.51
Vinyl chloride	.01	3.12	.16	3.28
Benzene	.24	2.64	.68	3.32
All Other VOCs	.61	22.33	.97	23.30
Total VOCs	22.03	468.67	20.98	489.67

In earlier Quarterly Reports, calculations for **Table 4-2** were based on the total system flow, as measured at the effluent discharge meter, and contaminant concentrations reported for the treatment system influent sample. The method of calculation was revised the 1st Quarter 2001 to each individual well flow and concentration because it is believed to be a more accurate representation of mass removal from the subsurface due to its independence on the time of sample collection.

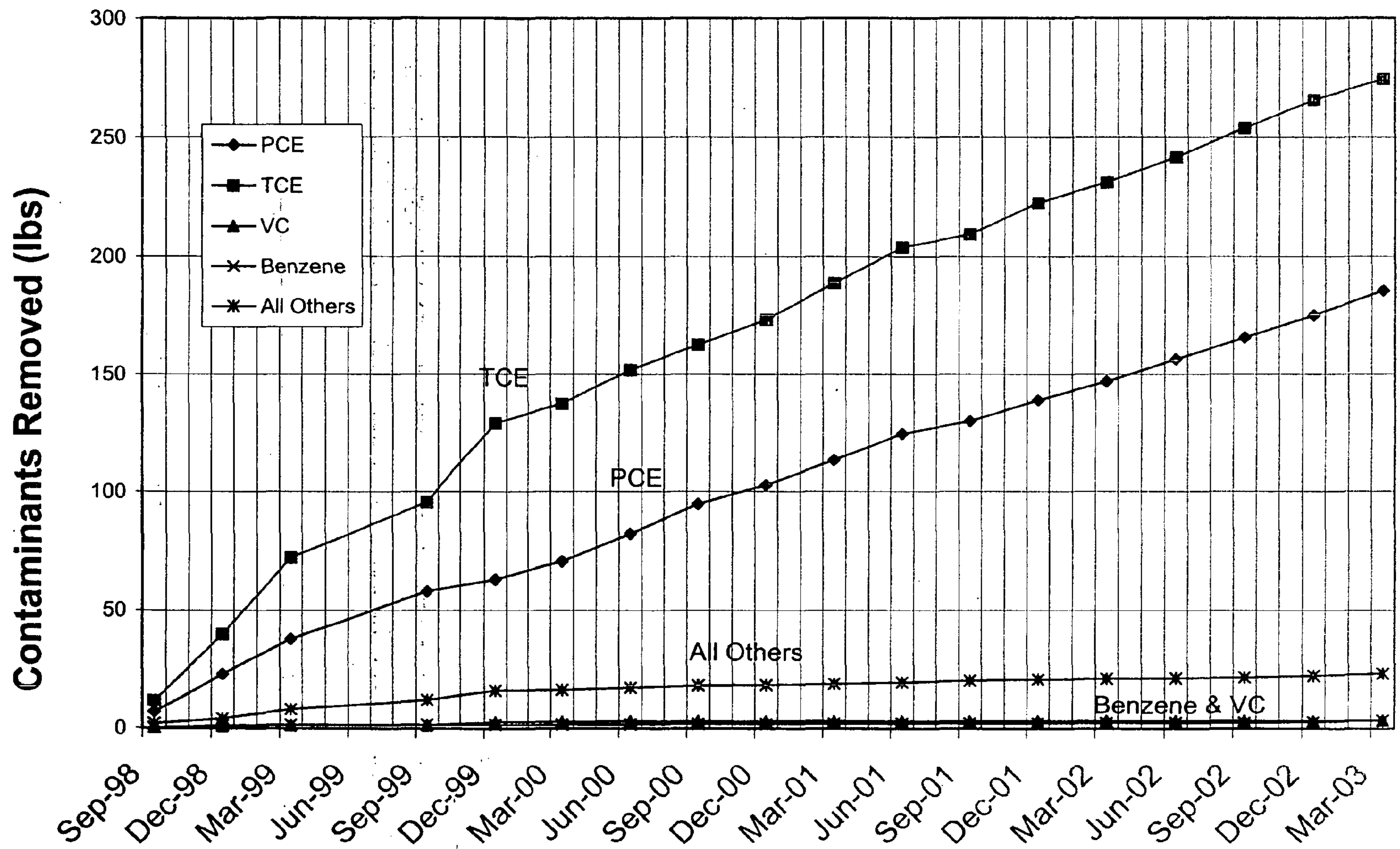
Cumulative mass extracted versus time is shown on **Figure 4-1.** This figure includes a cumulative time line for each of the five contaminant categories shown in the table above.

4.3.2 Individual Extraction Wells

Contaminant mass extraction for the individual extraction wells was computed based on flow during the quarter from the individual well and contaminant concentrations for the four major contaminants (PCE, TCE, vinyl chloride, and benzene), other VOCs, and total VOCs in the individual well. The cumulative mass extraction was computed by adding the contaminant mass calculated for this quarter to the cumulative mass calculated in the previous quarterly report. **Table 4-3** presents the individual well contaminant mass extracted from the subsurface for the 4th Quarter 2002 and 1st Quarter 2003 as well as the total cumulative mass extracted since inception. EW-10, which has the highest contaminant concentrations in the groundwater, is the leader in cumulative pounds of contaminant mass extracted at more than 112 pounds. EW-04, EW-06, and EW-10 removed the most VOC mass this quarter at 3.6 pounds, 4.8 pounds, and 5.6 pounds respectively. In comparing the two quarters, the contaminant mass removed decreased slightly, mainly attributed to the decreased groundwater contaminant concentrations in the most highly productive extraction wells.

Figure 4-1

Elmore Cumulative Contaminant Mass Removed



4.4 Monitoring Well Sampling Results

During the 1st Quarter of 2003, fifteen (15) groundwater monitoring wells and two (2) piezometers were sampled and analyzed for VOCs. The laboratory results of these analyses are presented in **Appendix A**. A summary of the detected VOCs in the monitoring wells and piezometeres is presented in **Table 4-4** and on **Figure 4-2** along with the sampling data for the extraction wells. The primary compounds detected were PCE and TCE, with low levels of several additional organics. The monitoring wells with the highest levels of contamination are MW-01I (center of the North extraction well line) and MW-14S (center of the South extraction well line). The contaminant concentrations at these 2 wells decreased slightly over last quarter but most of the other sampled monitoring wells had only moderate changes in contamination levels from last quarter.

MW-14S continues to reveal relatively low concentrations of PCE and TCE but high concentrations of benzene (2,000ug/l) and cis-1,2-DCE (400 ug/l). This is also reflected in the contaminant concentrations extracted from nearby EW-01S. The contamination is unique among all other wells at the Elmore site. However, it may be a direct consequence of neighbors pouring old gasoline on the ground near the well as witnessed by the system operator in the Spring 2002. This localized source of benzene may be encouraging underground bacterial populations to co-metabolize the PCE and TCE to the "degradation by-product" cis-1,2-DCE.

The six outlying perimeter wells (MW-02S&D, MW-12S&I and MW-13S&I) are only sampled annually and are not scheduled again until the 2nd Quarter 2003.

The newly installed monitoring wells down gradient from the intermediate extraction well line continues to show only trace levels of VOC contamination except at MW-18D where VOCs totaled 1,422 ug/l. MW-18D is a 120 foot deep well which may be revealing the Eastern edge of the contaminant plume whose center is located near EW-06. It may also demonstrate the downward migration of the volatile compounds in the groundwater as it flows Northward. The presence of trace amounts of volatiles in MW-16S, MW-16I, MW-17I and MW-17D suggests the capture zone of the intermediate depth extraction well line is not complete.

MW-15S is a new monitoring well installed 3rd Quarter 2002 and sampled for only the third time. Relatively low concentrations of PCE and TCE were found. The well was located in this vicinity to help identify the Eastern edge of the contaminant plume. The

Table 4-3
Individual Well Contaminant Mass Extracted by Quarter

Shallow Extraction Wells

EW01S	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.05	46	0.06	3.22
TCE	0.02	14	0.02	2.90
VC	0.00	3	0.00	0.00
Benzene	0.24	450	0.55	1.15
Other	0.26	267	0.33	2.10
Total VOCs	0.58	780	0.96	9.38

EW07S	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.13	160	0.45	7.59
TCE	0.04	46	0.13	7.54
VC	0.01	53	0.15	2.30
Benzene	0.00	44	0.12	1.89
Other	0.05	101	0.28	3.94
Total VOCs	0.23	404	1.14	23.28

EW08S	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.51	610	0.47	11.10
TCE	0.40	410	0.31	10.28
VC	0.00	0	0.00	0.03
Benzene	0.00	1	0.00	0.00
Other	0.02	43	0.03	1.02
Total VOCs	0.93	1,064	0.81	22.44

EW09S	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.00	3	0.00	0.01
TCE	0.00	2	0.00	0.10
VC	0.00	0	0.00	0.00
Benzene	0.00	0	0.00	0.00
Other	0.00	1	0.00	0.00
Total VOCs	0.01	6	0.00	0.12

EW10S	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	3.35	2,900	3.62	57.94
TCE	1.87	1,600	2.00	43.75
VC	0.00	0	0.00	0.20
Benzene	0.00	3	0.00	0.00
Other	0.02	20	0.02	10.41
Total VOCs	5.25	4,523	5.65	112.32

Intermediate Extraction Wells

EW02I	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.80	310	1.05	23.24
TCE	1.56	440	1.49	52.49
VC	0.00	0	0.00	0.32
Benzene	0.00	2	0.01	0.02
Other	0.05	8	0.03	2.24
Total VOCs	2.41	760	2.57	78.32

EW03I	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.07	530	0.06	1.86
TCE	0.11	740	0.08	4.29
VC	0.00	6	0.00	0.01
Benzene	0.00	3	0.00	0.00
Other	0.01	140	0.02	0.22
Total VOCs	0.19	1,419	0.16	6.38

EW04I	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	2.38	630	2.23	30.42
TCE	3.84	400	1.41	54.09
VC	0.00	0	0.00	0.00
Benzene	0.00	0	0.00	0.00
Other	0.04	10	0.04	0.68
Total VOCs	6.27	1,040	3.68	85.21

EW05I	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	0.15	100	0.46	14.49
TCE	0.32	110	0.50	31.04
VC	0.00	3	0.01	0.32
Benzene	0.00	0	0.00	0.26
Other	0.09	37	0.17	1.77
Total VOCs	0.56	250	1.15	47.89

EW06I	Prev Qtr lbs	1st Qtr 03 ug/L	1st Qtr 03 lbs	Cum. lbs
PCE	2.04	1,600	1.93	35.38
TCE	3.52	2,400	2.90	68.01
VC	0.00	0	0.00	0.10
Benzene	0.00	0	0.00	0.00
Other	0.07	38	0.05	0.92
Total VOCs	5.63	4,038	4.88	104.43

Table 4-4

Monitoring and Extraction Well Sampling Results

A. Monitoring Wells and Piezometers

	MW-01IB					MW-01I					MW-01D					MW-02S					MW-02D				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)	10	5	BDL	4	7	1600	1700	3400	2000	1200	4	5	0	5	11	-	BDL	-	-	-		BDL	-	-	-
TCE (ug/L)	6	4	BDL	4	5	2700	3600	8600	3800	2000	3	4	0	5	7	-	BDL	-	-	-		BDL	-	-	-
Total VOCs (ug/L)	19	12	2	10	15	4300	5349	12130	5882	3251	9	11	2	12	20	-	BDL	-	-	-		1	-	-	-

	MW-06S					MW-06I					MW-12S					MW-12I					MW-13S				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)	350	250	300	300	340	3	3	BDL	3	3	-	BDL	-	-	-	-	BDL	-	-	-	-	BDL	-	-	-
TCE (ug/L)	16	15	13	18	35	1	2	BDL	BDL	1	-	BDL	-	-	-	-	BDL	-	-	-	-	BDL	-	-	-
Total VOCs (ug/L)	366	265	315	318	378	8	10	5	7	9	-	BDL	-	-	-	-	1	-	-	-	-	BDL	-	-	-

	MW-13I					MW-14S ***					MW-14I					MW-15S					MW-16S				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)	-	BDL	-	-	-	90	63	100	56	41	BDL	BDL	BDL	BDL	BDL			6	6	42		9	12	2	5
TCE (ug/L)	-	BDL	-	-	-	31	25	38	26	22	BDL	BDL	BDL	BDL	BDL			5	5	5		20	27	3	2
Total VOCs (ug/L)	-	27	-	-	-	4993	2922	6282	2855	2509	BDL	BDL	BDL	BDL	BDL			11	13	47		31	40	5	9

	MW-16I					MW-16D					MW-17I					MW-17D					MW-18I				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)		6	5	6	7		BDL	BDL	BDL	BDL		BDL	1	6	1		BDL	BDL	BDL	2		BDL	BDL	2	2
TCE (ug/L)		14	13	17	18		BDL	BDL	BDL	BDL		BDL	4	6	3		BDL	BDL	BDL	1		BDL	BDL	2	4
Total VOCs (ug/L)		25	20	25	33		1	BDL	BDL	BDL		2	5	12	4		1	BDL	BDL	3		1	BDL	5	6

	MW-18D					PZ-01					PZ-02				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)		220	330	330	370				13	24				89	75
TCE (ug/L)		660	1000	1000	970				5	4				98	58
Total VOCs (ug/L)		932	1411	1413	1422				22	30				330	279

B. Extraction Wells

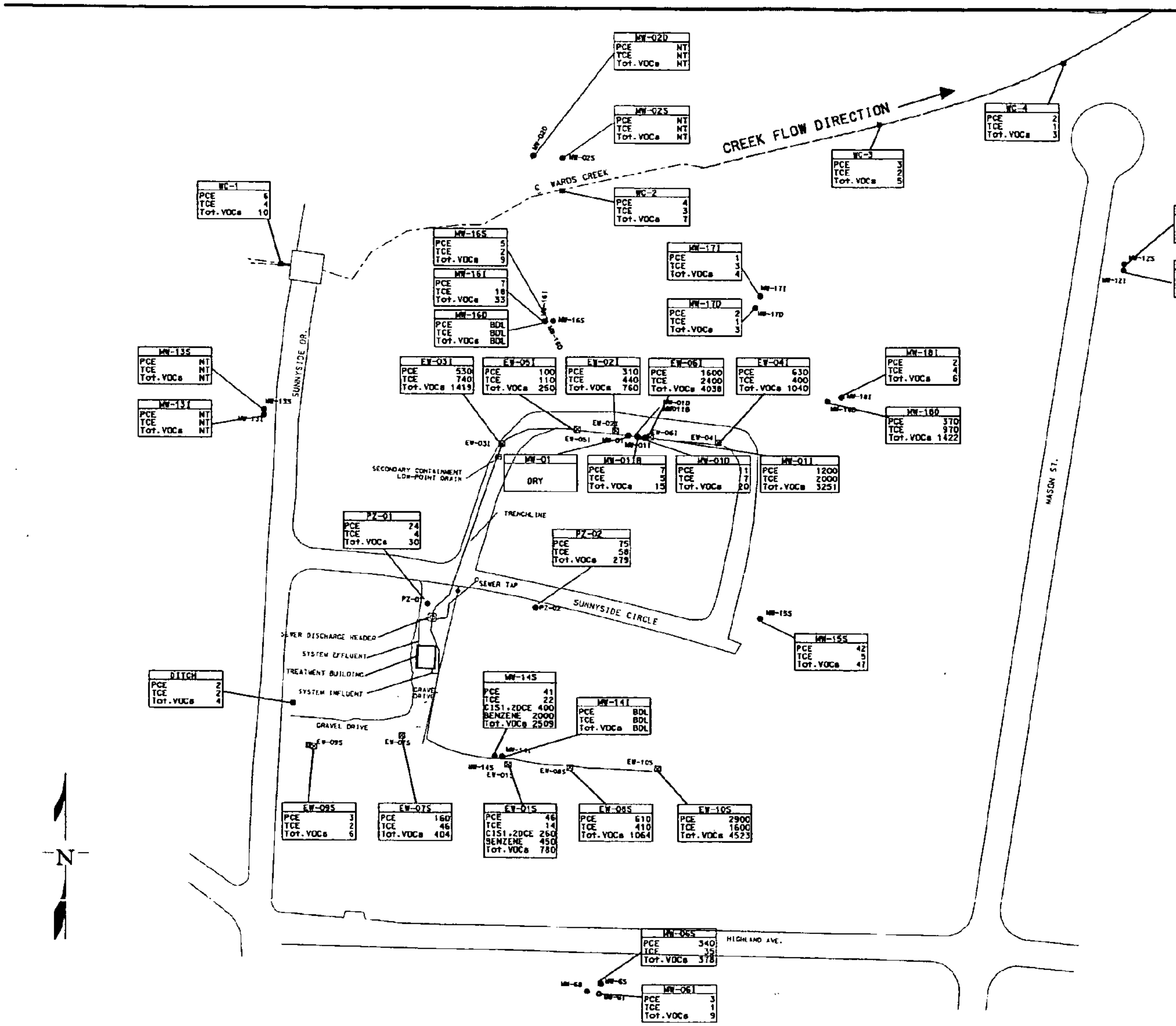
	EW-01S					EW-02I					EW-03I					EW-04I					EW-05I				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)	59	45	58	64	46	330	180	280	270	310	730	740	740	690	530	680	800	890	930	630	120	240	130	33	100
TCE (ug/L)	16	12	14	21	41	650	300	520	530	440	1300	1100	1300	1100	740	990	1200	1600	1500	400	180	320	180	72	110
Total VOCs (ug/L)	428	417	319	736	780	993	496	812	816	760	2175	1987	2183	1945	1419	1681	2000	2502	2447	1040	337	630	346	125	250

	EW-06I					EW-07S					EW-08S					EW-09					EW-10S				
Parameter	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03	Mar-01	Jun-02	Sep-02	Dec-02	Mar-03
PCE (ug/L)	1400	1900	2700	1800	1600	100	130	120	67	160	760	990	480	870	610	4	4	1	1	3	5700	5700	5600	4300	2900
TCE (ug/L)	2200	3200	5300	3100	2400	26	28	24	20	46	550	640	710	680	410	6	6	1	2	2	2700	3200	3500	2400	1600
Total VOCs (ug/L)	3600	5100	8050	4962	4038	172	216	180	118	404	1350	1655	1224	1592	1064	15	15	2	5	6	8400	8900	9114	6729	4523

Notes:

(shaded)	Shading indicates heavily contaminated well (Total VOCs above 1000 ug/l).
-	Dash indicates sampling performed only on an annual basis (in June), not quarterly.
BDL	Below detection limits.
DNA	Data not available.

*** MW-14S Total VOCs include high levels of Benzene and cis-1,2-DCE. (see Section 4.4 in the text).



NOTES

(1) Shallow extraction well screens are 30 ft long and collect water at depths from 20 ft to 50 ft below ground surface.

(2) Intermediate extraction well screens are 30ft long and collect water at depths from 50 ft to 80 ft below ground surface

LEGEND

- ---- Ward's Creek
- Monitoring Well
- ■ Surface Water Sampling Location
- ⊠ Extraction Well
- BDL Below Method Detection Limit
- J Estimated Value
- NT Not Tested

Well Number	
PCE	1000
TCE	2000
Tot.VOCs	3000

Numbers are concentrations in ppb.

GRAPHIC SCALE

VOC DETECTIONS FOR THE 1ST QUARTER 2003 SAMPLING EVENT
ELMORE WASTE DISPOSAL SITE, GREER, SOUTH CAROLINA

FIGURE 4-2

low levels of contaminants confirm the edge of the shallow groundwater plume. However, an intermediate depth monitoring well may be required to confirm the edge of deeper contamination since the plume may be migrating beneath MW-15S.

4.5 Extraction Well Sampling Results

During the 1st Quarter of 2003, ten groundwater extraction points were sampled and analyzed for VOCs. The results of these analyses are presented in **Appendix A**. A summary of the detected VOCs is presented on previous pages in **Table 4-4** and on **Figure 4-2**. The primary compounds detected were PCE and TCE, with low levels of several additional organics. Total VOC concentrations decreased significantly at EW-04I, EW-08S, and EW-10S. The other extraction wells showed minor, mixed changes compared to the previous quarter.

EW-10S remained the highest concentration of total VOC toxicity at 4,523 ug/l. Concentrations have been reducing at this location over the last 3 quarters and is an encouraging sign of potential contaminant reduction.

EW-09S continued to show the lowest contaminant concentrations and this quarters analytical result remains a reduced concentration compared to previous quarters. This may be a result of the well being converted from a shallow Spring Sump to a 30 foot deep extraction well which is screened across a 20 foot section of the saturated zone.

4.6 Wards Creek Sampling Results

During the 1st Quarter of 2003, four surface water locations along Wards Creek were sampled and analyzed for VOCs. The points are spaced approximately 200 feet apart and results help to evaluate if volatile contaminants are entering Wards Creek and volatilizing prior to reaching the normal downstream sampling point. Approximate locations of all four Wards Creek (WC) sampling points are shown on **Figure 4-2** presented earlier. The analysis of the four samples (WC-1,-2,-3,-4) showed low concentrations for PCE and TCE near/below target cleanup levels, yet a new phenomenon has occurred this quarter. The highest concentration of VOCs in the creek water occurred upstream at WC1 and gradually reduces at each progressive downstream sampling location. This progression of contamination change in the creek from upstream to downstream location is presented in **Figure 4-3a**. In the past the progression has been a concentration spike at the middle sampling points. Even so, the analysis of the creek samples continues to reflect concentrations below the target cleanup levels. The conclusion is still that some

Figure 4-3 a
VOC Concentrations Along Wards Creek (Mar 2003)

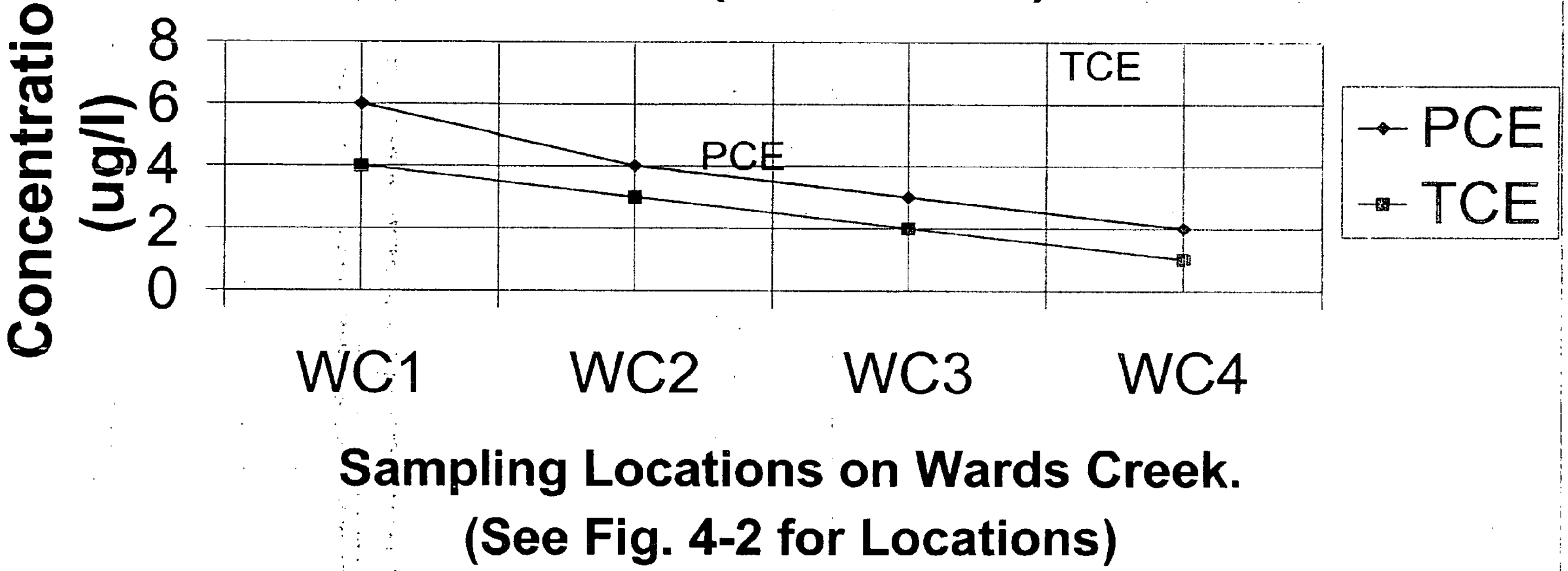
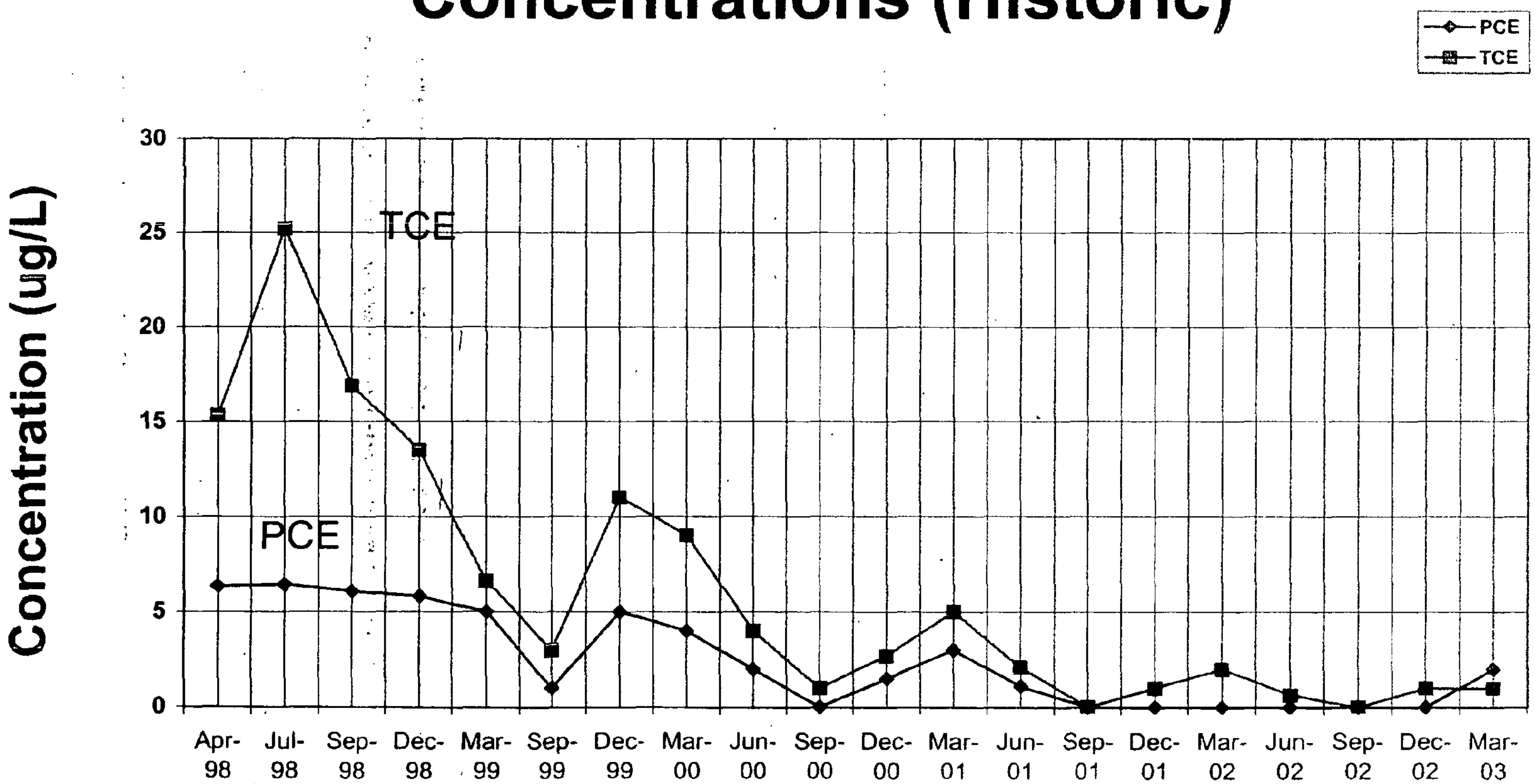


Figure 4-3 b
Wards Creek Downstream VOC Concentrations (Historic)



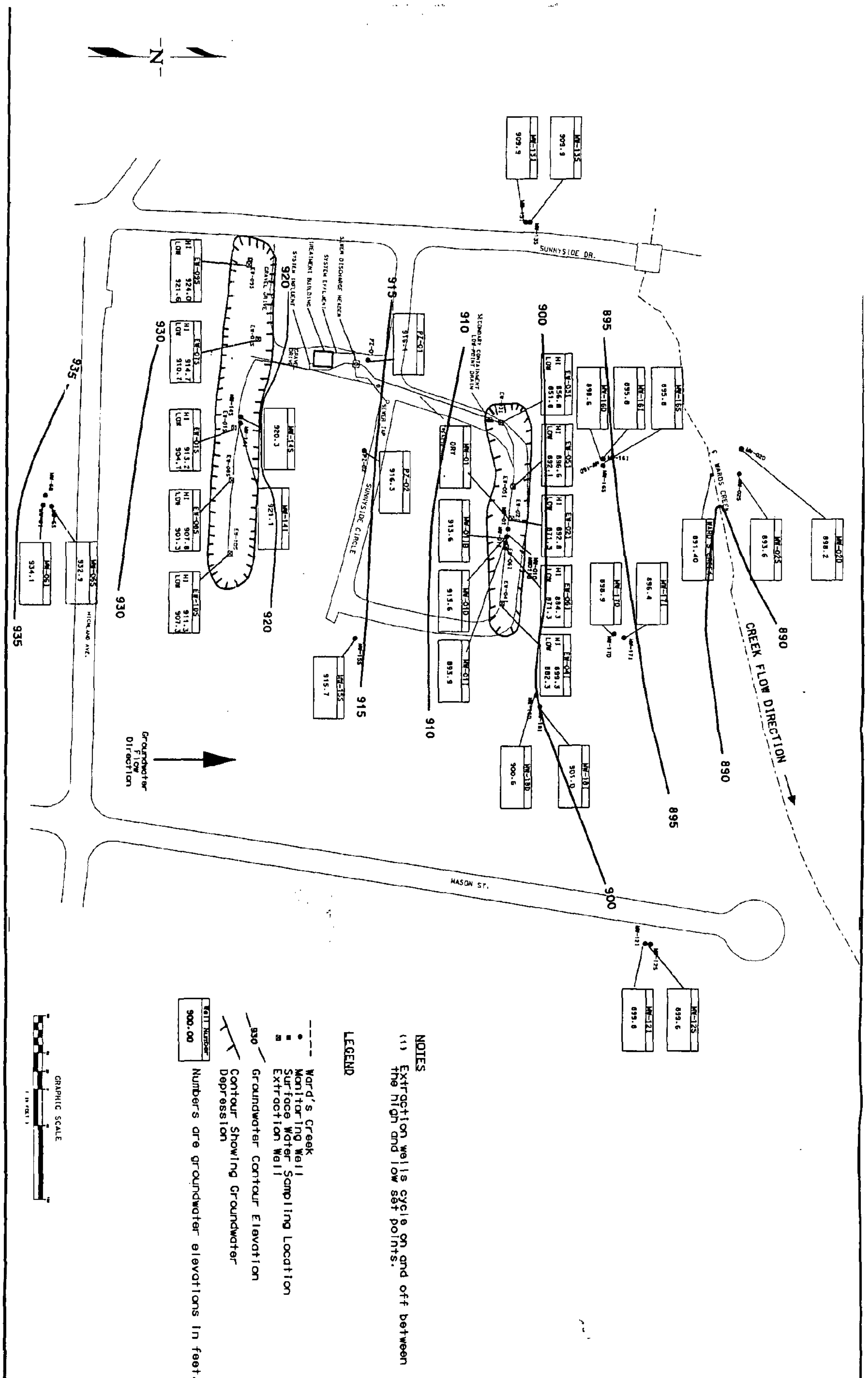
contaminated groundwater enters the creek waters from the Elmore site plume but is diluted and volatilizes significantly as it meanders downstream. Historical TCE and PCE concentrations at the farthest downstream location (Wards Creek 4) versus time is shown on **Figure 4-3b**. The downward trend of these contaminants since 1998 reflects positive impacts on the creek due to the pumping system of extraction wells. A cyclical phenomenon can be seen in **Figure 4-3b.** Every September beginning in 1999 shows a low point in the historical chart. This may be explained as a reflection of low rainfall during the preceding summer months retarding the movement of the contamination from source pockets in the saturated zone.

4.7 Monitoring Well Water Levels

Top of casing (TOC) elevations were measured at all wells using land surveying principals during the 2nd Quarter 2002 following installation of new monitoring wells. Locations and coordinates of the new and existing wells were also recorded to enable production of an updated potentiometric map of the groundwater beneath the Elmore site. Water levels were measured in the monitoring wells and piezometers during the Quarterly Sampling event and potentiometric elevations were calculated. The cycle-on and cycle-off water elevations in the extraction wells were also taken into account. The resulting potentiometric map is shown on **Figure 4-4**. The map depicts cones of depression along the shallow and intermediate extraction well lines, indicating the potential extent of drawdown of the groundwater table near these wells. Groundwater flow is in a Northerly direction towards Wards Creek. The addition of MW-15S in the 3rd Quarter 2002 allowed water levels to be calculated at this Eastern locality.

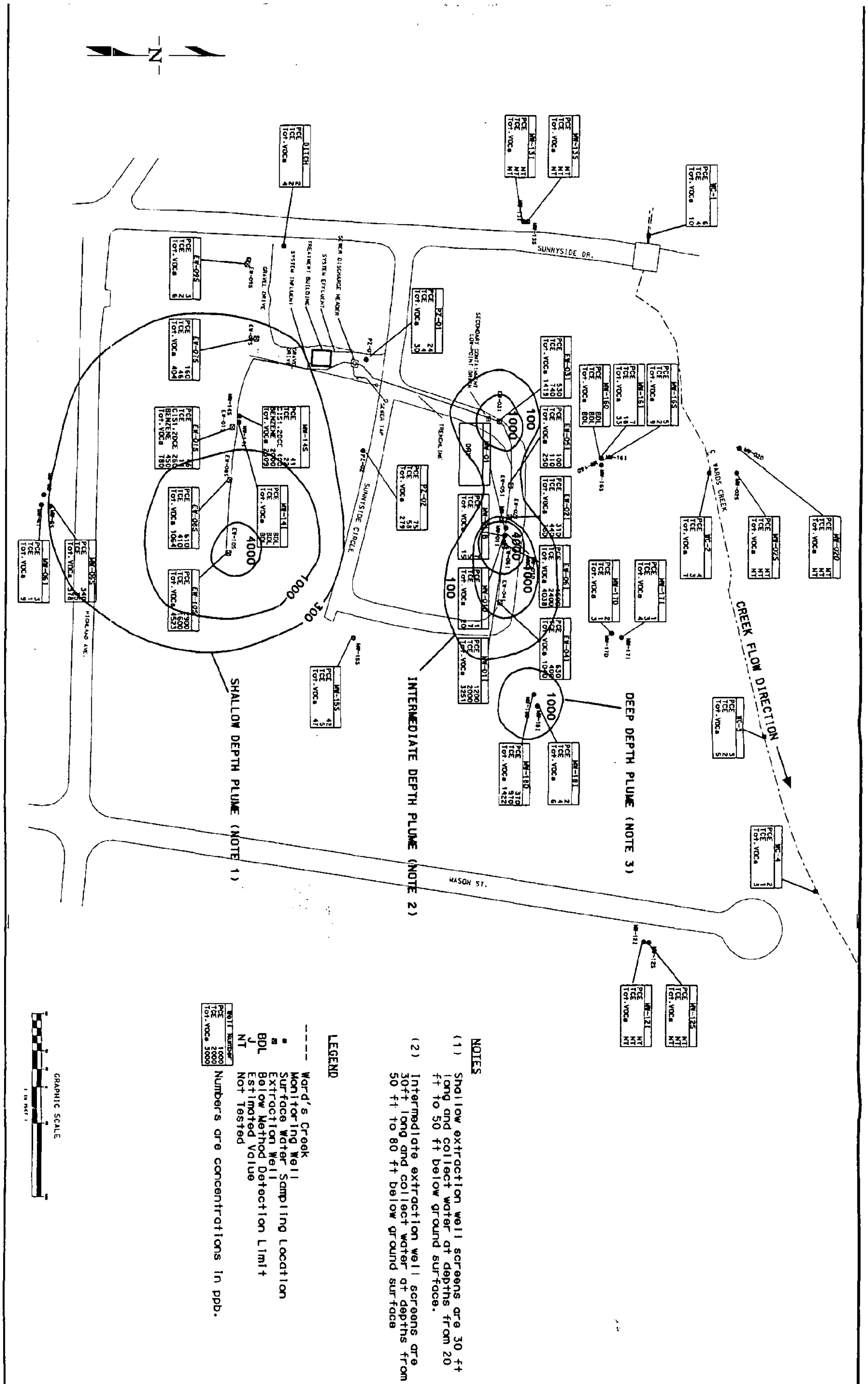
4.8 Contaminant Plumes

A plume map showing approximate zones of contamination was developed for this Quarterly Report and is represented as **Figure 4-5**. The areal extent of the plume contours around the extraction wells did not significantly change this quarter from the previous one. A deep plume horizon was identified in the 3rd Quarter 2002 and shown near new MW-18D. As stated in **Section 4.4**, this 120 foot deep well may be revealing the Eastern edge of the contaminant plume whose center is located near EW-06. It may also demonstrate the downward migration of the volatile compounds in the groundwater as it flows Northward. The analytical results of the piezometers sampled for the first time in the 4th Quarter 2002 helped further define the shallow plume between the extraction well lines.



POTENTIOMETRIC MAP FOR THE 1ST QUARTER 2003 SAMPLING EVENT
ELMORE WASTE DISPOSAL SITE, GREER, SOUTH CAROLINA

FIGURE
4-4



VOC DETECTIONS FOR THE 1ST QUARTER 2003 SAMPLING EVENT ELMORE WASTE DISPOSAL SITE, GREER, SOUTH CAROLINA	FIGURE 4-5

The concentration contours in the figure are based on VOC analyses for three different depths at different locations in the investigation area. Concentrations in the southern most plume are based on analytical results from shallow wells screened at intervals of approximately 20 to 50 feet below ground level. The intermediate depth plume is down gradient from the first plume area and is based on lab results from wells screened at approximately 50 to 80 feet below ground level. The deep contamination is based on analytical data from MW-18D which is screened from 110 to 120 feet below ground level. The plumes are likely connected, however they represent different horizons and reflect only a two dimensional rendition of the actual plume.

5.0 Recommendations

The Capture Zone Analysis Report was submitted last quarter and concluded the contaminant plume capture is not complete in either the shallow or intermediate aquifers. The presence of contaminants this quarter in the piezometers, MW-15S, MW-16S, MW-16I, MW-17I, MW-17D, MW-18I and MW-18D confirm the extraction wells are not achieving complete capture of the plume. However, historical positive impacts to Wards Creek as a result of the extraction system operation may demonstrate the pump and treat system is adequate as currently configured. Further discussion of the project goals and evaluation of clean up criteria is recommended prior to installing new extraction wells intending to achieve complete capture. To this end, the Remediation System Optimization (RSO) Report issued this quarter recommended several additional piezometers be installed and pump tests performed to more clearly understand existing capture zones and potential locations for new extraction wells. These recommendations are planned to be implemented next quarter.

Analytical results of the surface water samples collected from Wards Creek this quarter revealed a change from previous quarters' lab results. The highest concentration of VOCs in the creek water occurred upstream at location WC1 and gradually reduced at each progressive downstream sampling point. In the past the progression has shown a concentration spike at the middle sampling points. Even so, the analysis of the creek samples continues to reflect concentrations at or below the target cleanup levels. The reason for the upstream elevated contaminant level is unclear currently but the trend will be monitored for further changes.

The activated carbon in the Carbon Vessels show signs of treatment capacity exhaustion. However, the effluent concentrations remain below the current permitted discharge limit for TTO of 2,130 ug/l. It is recommended the influent and effluent water continue to be sampled monthly to ensure the TTO concentration remains below the permitted level. Replacement of the activated carbon is not recommended until the 2,130 ug/l TTO limit is exceeded in the effluent.

The newly installed shallow well, MW-15S, shows only slight contaminant levels. Further investigation is recommended to determine whether the plume is migrating through a deeper zone in this region. A future intermediate depth monitoring well installed nearby may aid in identifying the Eastern edge of the intermediate depth contaminant plume in this area.

Appendix A

Quarterly Groundwater Sampling Analytical Results
1st Quarter 2003

Appendix B [without supporting analytical data]

Quarterly DMR Sampling Results of Treatment System Effluent (Submitted January 2003 for 4th Qtr 2002)

BLACK & VEATCH

1145 Sanctuary Parkway
Suite 475
Alpharetta, Georgia 30004 USA

Tel: (770) 751-7517
Fax: (770) 751-8322

Black & Veatch Special Projects Corp.

U.S. Environmental Protection Agency
RAC 4 Assignment 004-RARA-04N3

BVSPC Project 48104.0149
January 26, 2003

Commission of Public Works
P.O. Box 216
Greer, SC 29652
Attention: Director, Industrial Pretreatment

Subject: 4th Quarter 2002 Discharge Monitoring Report (DMR)
Elmore Waste Disposal Superfund Site
Sunny Side Circle, Greer, SC Permit No. 013-03-NCI

Dear Sirs:

In accordance with the reporting requirements of the subject permit, attached please find the 4th Quarter 2002 Discharge Monitoring Report (DMR) and supporting analytical data for the period of October 1, through December 31, 2002. Please call me at (770) 521-8141 if any further clarification is needed.

Sincerely,

Black & Veatch Special Projects Corp.

Ed Hicks

Edward C. Hicks, P.E.
Project Manager

Attachments

cc: Ralph Howard, EPA
Alan Alewine, IT
File

DISCHARGE MONITORING REPORT (DMR)

GW-01
Permit Number

PERMITEE NAME/ADDRESS (INCLUDE FACILITY NAME/LOCATION

NAME: Black & Veatch Special Projects Corp.
ADDRESS: 1145 Sanctuary Parkway, Suite 475
Alpharetta, GA 30004
FACILITY: Elmore Site
LOCATION: 100 Sunnyside Circle, Greer

CPW
Commission of Public Works
P.O. Box 216
Greer, South Carolina 29652

MONITORING PERIOD									
Year	Month	Day	Time	TO	Year	Month	Day	Time
2002	10	01	12:00		2002	12	31	12:00

Parameter		Quantity or Loading: Average	Quantity or Loading: Maximum	Quantity or Loading: Units	Quality of Concentration: Minimum	Quality of Concentration: Average	Quality of Concentration: Maximum	Quality of Concentration: Units	Frequency of Analysis	Sample Type
Volatile Organic Compounds	Sample Measurement					1.43	1.43	mg/l		
	Permit Requirement	---	---			---	---		1/90	GRAB
Total Toxic Organics (TTO)	Sample Measurement							mg/l		
	Permit Requirement	---	---			---	2.13		1/365	GRAB
Copper	Sample Measurement			lbs/day				mg/l		
	Permit Requirement	0.17	0.25			0.4	0.6		1/365	GRAB
Lead	Sample Measurement			lbs/day				mg/l		
	Permit Requirement	0.08	0.12			0.2	0.3		1/365	GRAB
pH	Sample Measurement							S.U.		
	Permit Requirement	---	---		5		9		1/365	GRAB
Flow	Sample Measurement	20,203	27,300	GPD						
	Permit Requirement		50,000							

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE		
EDWARD C. HICKS, P.E.	"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information. The information submitted is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and inprisonment for knowing violations.	Edward C Hicks	770	521-8141	2003	1	27
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA CODE	NUMBER	YEAR	MO	DAY

Laboratory Name MITKEM Laboratory Address 175 Metro Center, Warwick, RI 02886 Laboratory S.C. Certification Number

Appendix C

Monthly Operations/Progress Reports
1st Quarter 2003

Elmore Groundwater Extraction and Treatment System

MONTHLY OPERATIONS/PROGRESS REPORT

Period of: January 2003

Flow Meter Reading End of Previous Mo. 25,129,200 (on 12/27)

Flow Meter Reading End of this Month 25,830,300 (on 1/31)

Gallons During this Period 710,100

Extraction System Data:

Location	Monthly Production (GAL)	Cumulative Production (GAL)	Average Wtr.Level (ft above xducer)	Avg. Daily Flow (gal/day)	Notes
EW-01S	42,786	1,189,046	12.9	1,483	Well operating in auto.
EW-02 I	131,880	6,136,165	28.5	4,630	Well operating in auto.
EW-03 I	4,416	220,004	9.8	153	Well operating in auto.
EW-04 I	132,144	6,077,487*	39.8	4,562	Well operating in auto.
EW-05 I	150,635	4,359,587	41.8	5,492	Well operating in auto.
EW-06 I	37,054	2,237,689	26.4	1,604	Well operating in auto.
EW-07S	96,067	2,971,302	14.1	4,169	Well operating in auto.
EW-08S	24,050	956,960	5.3	1,057	Well operating in auto.
EW-09S	0	500,602	19.8	0	Well is off. Flow meter defect.
EW-10S	37,272	1,409,480	5.4	1,650	Well operating in auto.
Transfer Pump					
Totals:	656,304	26,058,322 *		24,201	

* Includes a 90,923 gallon adjustment due to a cumulative flow reading decrease of 90,923 gallons during the month of November 1999.

Treatment System/Controls Data:

1. The ProControl PLC System required attention this month. A faulty flowmeter at EW-09 caused a drain of the 24V power supply. This drained the UPS system and caused a shutdown of both Control Systems A&B. After isolating the faulty wire, further troubleshooting indicated a weak UPS unit, unable to hold a full charge after recharging overnight. A new UPS was installed in the control panel (see **Photos 1&2**).

Previous Flow Data:

Month	Monthly Flow (gal)	To Date Flow (gal)
Nov 2002	593,700	24,467,100
Dec 2002	662,100	25,129,200
Jan 2003	701,100	25,830,300

Operational Notes

Activities Performed This Month: Site visits were made each of the 5 weeks during the month of January. Monitoring and routine maintenance took place during these visits. Overall, the collection system performed properly this month except that the ProControl System required a new UPS unit as described on the previous page (see **Photos 1&2**). An average of over 140,000 gallons of groundwater was collected during each of the 5 weeks this month by the system, with approximately 23,000 gallons pumped daily.

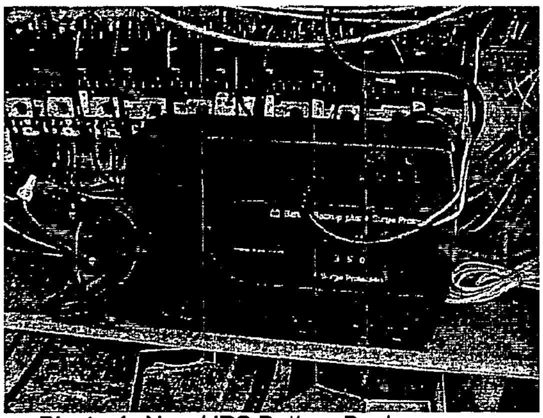


Photo 1: New UPS Battery Backup.

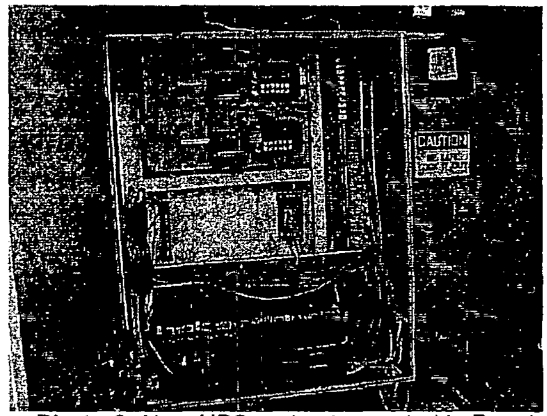


Photo 2: New UPS, not yet mounted in Panel.

The Annual Well Inspection event occurred at the site on 1/27 & 1/28. Pumps, flowmeters, transducers, etc were cleaned and inspected (see **Photo 3**). No major problems were noted. Transducers are recording accurate water levels. Two wells had broken suspension cables and were repaired. Minor leaks from pipe fittings in 2 well vaults were sealed.

Pump turn-on levels were lowered for EW-01, EW-04, and EW-06 to increase their daily extraction rate. Well extraction rates will be monitored and adjusted periodically to improve their capture zones as recommended in the recent Capture Zone Analysis Report.

Monthly Influent and Effluent water samples were collected on 1/28. Results will be used to verify permitted TTO discharge limits of 2.13 mg/l are not exceeded. Should limits be exceeded, activated carbon replacement will be required. To date, effluent samples have been within permitted limits.

Regularly scheduled preventive maintenance was conducted on 1/16. Carbon Vessel #1 was backwashed because of high pressure buildup. Bag filters and transducer drying tubes were checked & changed. The Equalization Tank was cleaned along with the internal float switch, and the overall system was checked. The low-point drain was emptied of 30 gallons of water. The heater temperature setting inside the Treatment Building was lowered from 60^{o}F to 56^{o}F as a cost savings measure (see **Photo 4**).

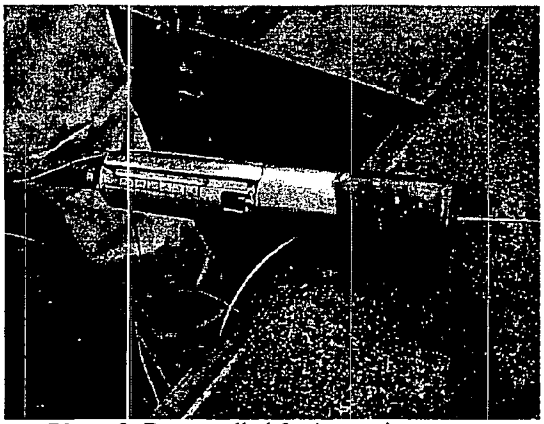


Photo 3: Pump pulled for inspection.

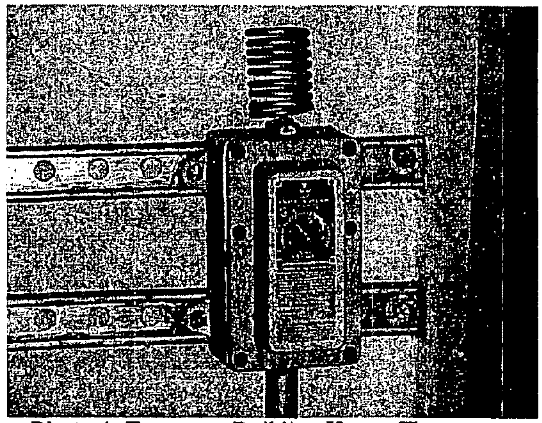


Photo 4: Treatment Building Heater Thermostat.

Problems/Potential Problems:

1. Contaminant break-through has occurred in all three of the carbon vessels onsite. The system was allowed to continue operating "as is" without changing out the activated carbon but to increase the sampling frequency for the influent and effluent to a monthly basis to verify permit limits are not exceeded. The City of Greer CPW has agreed with this course of action which has been ongoing since October 2001.

Recommended Action Items:

1. Continue to monitor the 4" secondary containment low point drain for leaking water from the interior 2" header pipe.
2. Review analytical results of influent and effluent water to ensure the treatment system is meeting the permit requirements for discharging water.

Project Planning Notes:

1. The Remediation System Optimization Report was submitted to EPA this month.
2. The Quarterly DMR was sent to the City of Greer this month covering the 4th Quarter of 2002.
3. The 4th Quarter 2002 Report will be issued to EPA in February.
4. EPA is planning an indoor air monitoring program in 1st Quarter 2003.

Activities Planned For Next Month:

1. Weekly data collection, scheduled maintenance, & monthly operation report.
2. Collect influent and effluent water samples to monitor permitted discharge limits.
3. 1st Quarter 2003 sampling event.

Attachment 1: Weekly Operations Reports

Prepared By: Alan Alewine
Date: 02/04/2003

Elmore Groundwater Extraction and Treatment System

MONTHLY OPERATIONS/PROGRESS REPORT

Period of: February 2003

Flow Meter Reading End of Previous Mo. 25,830,300 (on 1/31)
Flow Meter Reading End of this Month 26,467,800 (on 2/28)

Gallons During this Period 637,500

Extraction System Data:

Location	Monthly Production (GAL)	Cumulative Production (GAL)	Average Wtr.Level (ft above xducer)	Avg. Daily Flow (gal/day)	Notes
EW-01S	47,474	1,236,520	12.0	1,624	Well operating in auto.
EW-02 I	132,327	6,268,492	31.2	4,515	Well operating in auto.
EW-03 I	4,401	224,405	7.4	152	Well operating in auto.
EW-04 I	138,725	6,216,212*	39.9	4,741	Well operating in auto.
EW-05 I	140,223	4,499,810	42.0	4,916	Well operating in auto.
EW-06 I	54,052	2,291,741	26.8	1,904	Well operating in auto.
EW-07S	117,675	3,088,977	14.6	4,135	Well operating in auto.
EW-08S	32,478	989,438	5.3	1,133	Well operating in auto.
EW-09S	863	501,465	19.1	31	Well off most of month. Flow meter defect.
EW-10S	54,531	1,464,011	5.2	1,920	Well operating in auto.
Transfer Pump					
Totals:	722,749	26,781,071 *		25,072	

* Includes a 90,923 gallon adjustment due to a cumulative flow reading decrease of 90,923 gallons during the month of November 1999.

Treatment System/Controls Data:

1. The ProControl PLC System operated satisfactorily this month.

Previous Flow Data:

Month	Monthly Flow (gal)	To Date Flow (gal)
Dec 2002	662,100	25,129,200
Jan 2003	701,100	25,830,300
Feb 2003	637,500	26,467,800

Operational Notes

Activities Performed This Month: Site visits were made each of the 4 weeks during the month of February. Monitoring and routine maintenance took place during these visits. Overall, the collection system performed properly this month. An average of over 150,000 gallons of groundwater was collected during each of the 4 weeks this month by the system, with approximately 25,000 gallons pumped daily.

Troubleshooting the flow meter at EW-09 was required this month. A drain of the 24V power system had shut down the ProControl systems last month. The well had to be shut down for most of the month and its 24V flowmeter power wire disconnected (see **Photo 1**). The spare flow meter was installed to replace the existing one. After extensive troubleshooting, a shorted wire was isolated inside the well vault. It was cut away and cables respliced (see **Photo 2**). The waterproof splice was elevated to the top of the vault to ensure it would not become submerged. During the flowmeter effort, a new transducer bellows was also installed to replace the old one suspected of containing moisture. The well was then successfully restarted in automatic mode on 2/28.

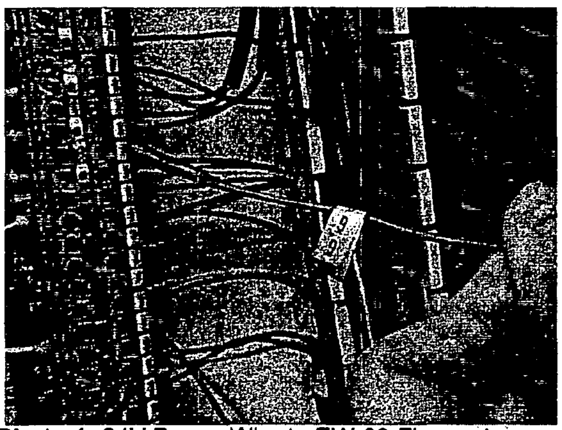


Photo 1: 24V Power Wire to EW-09 Flowmeter.

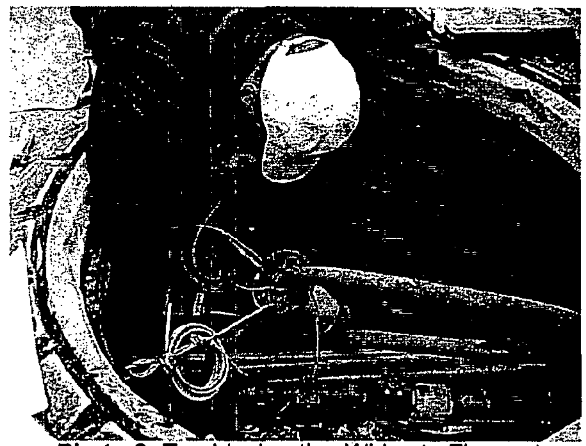


Photo 2: Troubleshooting Wiring to Flowmeter.

The 1st Quarter 2003 Sampling Event was performed this month on 2/17, 2/18, & 2/19 (see **Photo 3**). A total of 35 locations were sampled for analysis of VOCs. In addition, Influent and Effluent volumes were collected for analysis of BNAs and Pesticides/PCBs as required annually for the DMR permit. Analytical results will be documented in the 1st Quarter Report after the quarter ends.

A neighborhood meeting was conducted by EPA on 2/20 to discuss upcoming testing events with the nearby residents. An air monitoring/sampling event is planned for this quarter to determine the potential of contaminated air entering homes from the groundwater plume (see *Public Meeting Notice*, **Figure 1**).

Wooden pallets, plastic sheeting, and sandbags were removed from the former drum storage site this month. The wooden pallets are temporarily stored behind the Treatment Building and will be disposed of at a later date (see **Photo 4**).

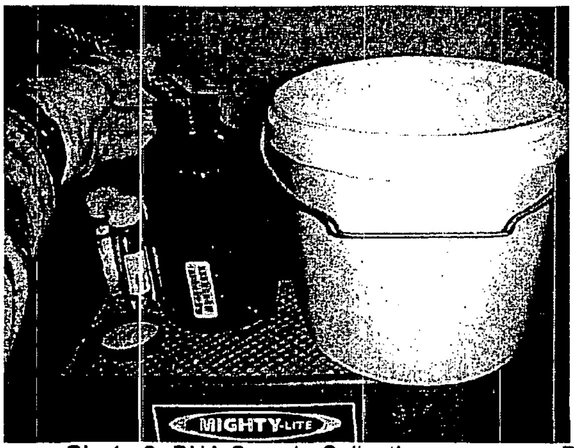


Photo 3: BNA Sample Collection.

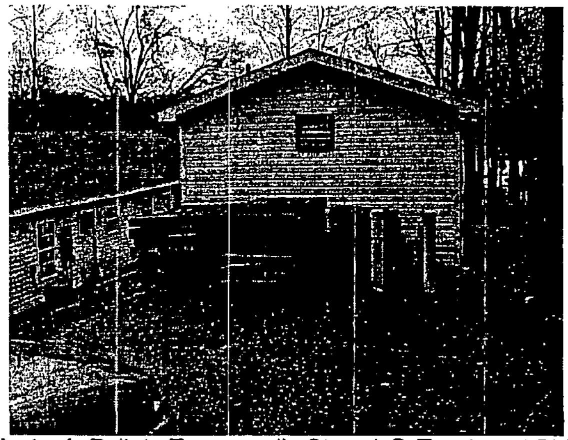


Photo 4: Pallets Temporarily Stored @ Treatment Bldg

Pump turn-on levels were lowered for EW-04,EW-05, and EW-06 this month to increase their daily extraction rate and improve the capture zone of each. Well extraction rates will be monitored and adjusted periodically to improve their capture zones as recommended in the recent Capture Zone Analysis Report.

Monthly Influent and Effluent water samples were collected during the Quarterly Sampling event. Results will be used to verify permitted TTO discharge limits of 2.13 mg/l are not exceeded. Should limits be exceeded, activated carbon replacement will be required. To date, effluent samples have been within permitted limits.

During regularly scheduled preventive maintenance this month, both on-line carbon vessels were backflushed due to pressure buildup. Bag filters were changed, pump amperages recorded, drying tubes checked, and general housekeeping was done. 15 gallons of water was removed from the low-point drain.

Problems/Potential Problems:

1. Contaminant break-through has occurred in all three of the carbon vessels onsite. The system was allowed to continue operating "as is" without changing out the activated carbon but to increase the sampling frequency for the influent and effluent to a monthly basis to verify permit limits are not exceeded. The City of Greer CPW has agreed with this course of action which has been ongoing since October 2001.

Recommended Action Items:

1. Continue to monitor the 4" secondary containment low point drain for leaking water from the interior 2" header pipe.
2. Review analytical results of influent and effluent water to ensure the treatment system is meeting the permit requirements for discharging water.

Project Planning Notes:
1. Received comments from EPA on the Remediation System Optimization Report this month.
2. Received comments from EPA on the Capture Zone Analysis Report this month.
3. The 4^{th} Quarter 2002 Report will be issued to EPA in March.
4. EPA is planning an indoor air monitoring program in 1^{st} Quarter 2003.

Activities Planned For Next Month:
1. Weekly data collection, scheduled maintenance, & monthly operation report.
2. Collect influent and effluent water samples to monitor permitted discharge limits.

Figure 1: Public Meeting Notice
Attachment 1: Weekly Operations Reports

Prepared By: Alan Alewine
Date: 03/07/2003

Availability Session/ Neighborhood Meeting

Thursday, Feb. 20, 2003
7:00 p.m.

Mr. Darryl Grady's Activity Building
Sunnyside Drive at Sunnyside Circle
Greer, South Carolina

Since 1998, the U.S. Environmental Protection Agency (EPA) has been implementing a groundwater cleanup project for the Elmore Waste Disposal Superfund Site in Greer, South Carolina. The cleanup operation uses a 10-well pump-and-treat system located in the Sunnyside Circle neighborhood. EPA is the lead agency for this work under Superfund, and the the South Carolina Department of Health and Environmental Control (SCDHEC) is the support agency.

During 2002, a variety of work was conducted by EPA and its cleanup contractor as part of a "system improvement" task. An Availability Session/Neighborhood Meeting was held on Feb. 5, 2002, to discuss plans for these activities and to update residents on the progress of the groundwater cleanup.

As EPA stated at that meeting, one of the planned tasks was to investigate the possibility that air-borne contamination in vapor form, coming up from the groundwater underlying the Sunnyside neighborhood, might be present in ambient air within homes. (This potential problem was investigated in 1994, with negative results.) To investigate this, soil gas sampling (sampling of air present in the ground), from 12 temporary well-points installed in the neighborhood, was conducted in May 2002.

The laboratory results, which became available in August 2002, do not indicate any immediate threat to health. The results were then compared to long-term health-risk standards using worst-case assumptions, in order to consider whether such risks could be present. Results of this comparison indicate that it is *possible* there could be potential long-term health risks. EPA believes that further, definitive sampling of home crawl spaces in the neighborhood is needed.

In many instances there are mitigating factors that prevent vapors from entering homes, including whether the home is built on a slab or has a crawl space, the degree of house and crawl space ventilation, climate, and others.

At this meeting, the EPA Project Manager will discuss the reasons for sampling crawl spaces under homes in the neighborhood, and the possible outcomes of this work. US EPA is responsible for the Site cleanup work, including any protective measures that may prove to be required to eliminate potential risks.

Residents who cannot attend this meeting are encouraged to call the Project Manager (see below) to schedule a time for a brief meeting with EPA. Each resident will be contacted in person before any sampling is done at each property.

FOR MORE INFORMATION

Please contact:

Stephanie Y. Brown
Community Involvement Coordinator
OR
Ralph O. Howard, Jr.
Remedial Project Manager

1-800-435-9233

Figure 1: Public Meeting Notice

Elmore Groundwater Extraction and Treatment System

MONTHLY OPERATIONS/PROGRESS REPORT

Period of: March 2003

Flow Meter Reading End of Previous Mo. 26,467,800 (on 2/28)

Flow Meter Reading End of this Month 27,289,800 (on 3/28)

Gallons During this Period 822,000

Extraction System Data:

Location	Monthly Production (GAL)	Cumulative Production (GAL)	Average Wtr.Level (ft above xducer)	Avg. Daily Flow (gal/day)	Notes
EW-01S	57,133	1,293,653	10.9	2,040	Well operating in auto.
EW-02 I	142,190	6,410,682	27.9	5,078	Well operating in auto.
EW-03 I	4,374	228,779	7.3	156	Well operating in auto.
EW-04 I	153,721	6,369,933*	38.0	5,490	Well operating in auto.
EW-05 I	258,229	4,758,039	40.2	9,222	Well operating in auto.
EW-06 I	53,898	2,345,639	26.7	1,925	Well operating in auto.
EW-07S	124,290	3,213,267	14.1	4,439	Well operating in auto.
EW-08S	35,155	1,024,593	4.9	1,255	Well operating in auto.
EW-09S	29,529	530,994	18.4	1,055	Well off most of month. Flow meter defect.
EW-10S	58,082	1,522,093	5.2	2,074	Well operating in auto.
Transfer Pump					
Totals:	916,601	27,697,672 *		32,735	

* Includes a 90,923 gallon adjustment due to a cumulative flow reading decrease of 90,923 gallons during the month of November 1999.

Treatment System/Controls Data:

1. The ProControl PLC System operated satisfactorily this month.

Previous Flow Data:

Month	Monthly Flow (gal)	To Date Flow (gal)
Jan 2003	701,100	25,830,300
Feb 2003	637,500	26,467,800
Mar 2003	822,000	27,289,800

Operational Notes

Activities Performed This Month: Site visits were made each of the 4 weeks during the month of March. Monitoring and routine maintenance took place during these visits. Overall, the collection system performed properly this month. An average of over 200,000 gallons of groundwater was collected during each of the 4 weeks this month by the system, with approximately 30,000 gallons pumped daily.

Heavy rains this month caused a rise in the groundwater table and consequently flooded the EW-09 vault. With the flowmeter underwater, volume and flow were not being recorded. The well is turned off temporarily until the water table drops slightly again. In the meantime, prices are being sought for a waterproof flowmeter for this well.

The local newspaper reported the upcoming air sampling event planned soon by EPA. The article is attached as **Figure 1** to this report. The air sampling will test whether contaminated groundwater may be affecting air inside the homes of local residents.

EPA surveyed the top of casing (TOC) elevation of MW-15S on 3/12. The elevation had previously been estimated but was determined to be 941.93 ft.

Monthly samples of the influent and effluent water were collected on 3/18 to verify the permitted discharge limits for TTO are not exceeded. This voluntary action is undertaken monthly because the treatment capacity of the carbon beds has been exhausted. Fresh carbon will be required should the TTO discharge limit of 2.13 mg/l be exceeded. To date, effluent samples have been within permitted limits.

This month, flow meters at EW-05 & EW-06 required cleaning as a consequence of receiving low flow alarms from these wells (see **Photo 1**).

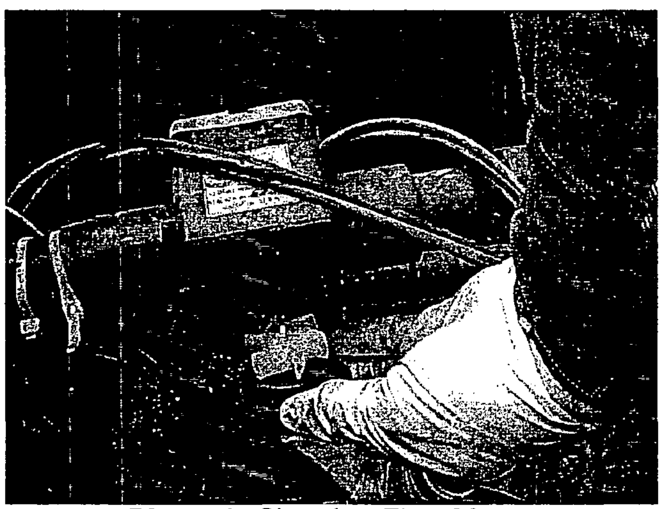


Photo 1: Cleaning Flow Meter.

Pump turn-on levels were lowered for EW-01 and EW-06 this month to increase their daily extraction rate and improve the capture zone of each. Well extraction rates will be monitored and adjusted periodically to improve their capture zones as recommended in the recent Capture Zone Analysis Report.

During regularly scheduled preventive maintenance this month on 3/28, bag filters were changed, drying tubes checked, and the lead carbon vessel was backwashed to reduce internal pressure buildup.

Problems/Potential Problems:

1. Contaminant break-through has occurred in all three of the carbon vessels onsite. The system was allowed to continue operating "as is" without changing out the activated carbon but to increase the sampling frequency for the influent and effluent to a monthly basis to verify permit limits are not exceeded. The City of Greer CPW has agreed with this course of action which has been ongoing since October 2001.

Recommended Action Items:

1. Continue to monitor the 4" secondary containment low point drain for leaking water from the interior 2" header pipe.
2. Review analytical results of influent and effluent water to ensure the treatment system is meeting the permit requirements for discharging water.
3. Procure and install a waterproof flowmeter for the EW-09 vault.

Project Planning Notes:

1. The 4th Quarter 2002 Report was issued to EPA on March 3rd.
2. EPA is planning an indoor air monitoring program in 2nd Quarter 2003.
3. All extraction wells will be temporarily shut down for several days in April to allow groundwater levels to stabilize for the purpose of conducting a groundwater flow direction study by others. Installation of several temporary wells are also planned by others in the railroad right-of-way to augment this study.
4. Based on discussions between the RPM and BV, BV will prepare a draft Variance Request for the performance of a pump test on Monitoring Well No. MW-18D, and the installation of 11 additional piezometers, in accordance with the recommendations in the draft RSO Report. This additional work is tentatively scheduled to be performed in Spring 2003.

Activities Planned For Next Month:

1. Weekly data collection, scheduled maintenance, & monthly operation report.
2. Collect influent and effluent water samples to monitor permitted discharge limits.

Figure 1: Greenville News Article
Attachment 1: Weekly Operations Reports

Prepared By:	Alan Alewine
Date:	04/08/2003

State to test air in Greer residences

EPA had removed contaminated soil from the sites

By Angelia Davis
STAFF WRITER
adavis@greenvillenews.com

GREER — Federal environmental regulators will conduct tests to determine whether underlying contaminated groundwater is affecting air inside 20 Greer homes.

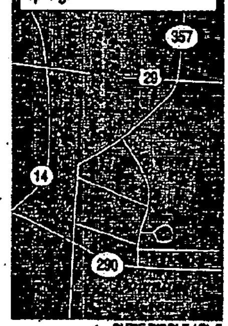
Ralph Howard Jr., remedial project manager for EPA, said the agency will collect air samples in the crawl space underneath the homes as part of its monitoring of groundwater around the Elmore Waste Disposal Superfund site near State 290 and Sunnyside Drive.

But some residents in the Sunnyside neighborhood question why the U.S. Environmental Protection Agency didn't do such testing underneath their homes in 1994, when it removed contaminated soil.

Resident Timmy Cooper said he recalls residents telling EPA then that more testing needed to be done underneath the homes.

"We should have had people look into it last time. This is one of the things we were afraid of," said Cooper, a member of the area's Community In Action group.

Air samples
Representatives from the U.S. Environmental Protection Agency are expected to begin collecting air samples from beneath 20 homes in the Sunnyside area in Greer this spring.



SUZIE RIDDLE / Staff

Howard said the new tests will be done because of concerns expressed to the agency that soil wasn't dug out from under crawl spaces in 1994, and some people feared they could be affected. But the cleanup done then and the tests that will be done in March or April aren't connected, he said.

He said the soil removal in 1994 was to address contaminated soil left from operations on the old Sunnyside dump. Some crawl space sampling also was done, but it was intended to look for problems related to groundwater.

He said the state of knowledge about groundwater and the vapors years ago wouldn't have led EPA and private science to consider or find it necessary to conduct the type of tests that are planned for this spring.

The Elmore site was used to store industrial waste oils in containers from 1975 until 1986.

Some barrels leaked, contaminating the soil and groundwater, primarily with trichlorethylene (TCE) and tetrachloroethylene (PERC). The contamination slowly flowed from the Elmore hazardous waste site and under the Sunnyside neighborhood and into Wards Creek, health officials have said.

Kevin Koporec, an EPA toxicologist, said the biggest health concern from the two contaminants is cancer, "assuming someone is going to be exposed for 30, 50, 70 years or so."

Howard said the goal of the soil removal in Sunnyside was to remove surface soil laden with lead, so residents would have clean soil for safe use in their yards.

EPA has been involved in cleaning groundwater there since 1998. Howard said it costs an average of $140,000 a year to operate the pump and treat the groundwater system.

In 2002, the agency tested samples of soil gas taken from 11 temporary vapor wells in Sunnyside to determine whether airborne contamination could come up from underlying groundwater and exist in air within the homes.

Some of the air samples showed numbers of the same chemicals that are in the groundwater. And in some, the amounts were in higher numbers than risk assessors say is definitely safe, Howard said.

However, he said, none of the levels represent an immediate health threat.

Howard said the groundwater beneath the homes is contaminated but not to the same degree in different locations.

The upcoming air testing will take two to three days to complete. The agency could get results in four to six weeks, he said.

He said if problems are found, the agency likely will move to fix them by creating ventilation under the homes.

Figure 1: Greenville News Article.

Appendix D

Annual Well Inspection Report
January 2003

IT Corporation

30 Patewood Drive
Bldg 2, Suite 370
Greenville, SC 29615-3535
Tel. 864-254-9285
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A Member of The IT Group

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Global Environmental Solutions Firm

the IT group

F A C S I M I L E

To:	Ed Hicks, B&V	From:	Alan Alewine
Location:	Alpharetta, GA		
FAX Number:	770-751-8322		
Page 1 of	9	Ref:	Elmore Annual Well Inspection, January 2003
Date:	January 30, 2003		

Ed,

Attached are 2 short spreadsheets (2 pages) and sketches (5 pages) showing our findings from the Annual Well Inspection at Elmore performed on Monday & Tuesday, 1/27/03 and 1/28/03.

Each extraction well pump and transducer was pulled, inspected, cleaned, and tested during the event (see **Photo**). Pumps and cables were examined for signs of corrosion. Two broken suspension cables were repaired and two vaults required repair of dripping pipe fittings.

A heavy red slime buildup is on the pumps at EW-02 and adjacent EW-06. This does not seem to effect the pumps operation or capacity but may cause future problems.

Transducer water level readings were checked and verified. The transducers in all the wells are giving accurate readings of the water level above the transducer based on our rough field measurements (see attached spreadsheet).

Pump model numbers and amperage readings were documented. Pump amperage readings taken at the control panel showed no significant differences with the previous inspection, indicating no electrical shorts or power leaks have developed (see attached spreadsheet).

No other significant observations or problems were noted. This completes the annual well inspection effort for this period.

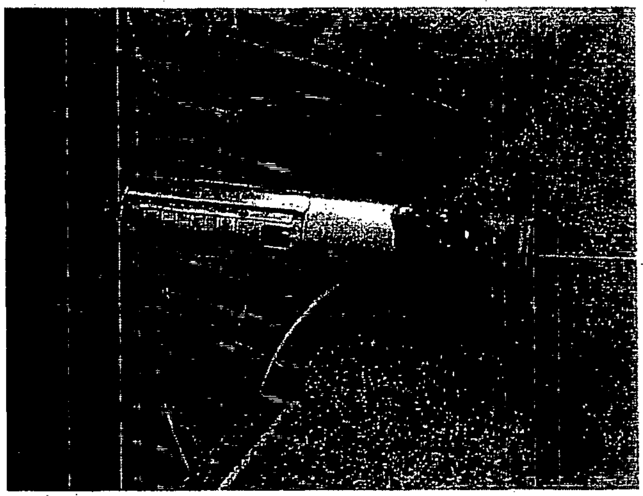

Photo: Pump from EW-03 pulled for Annual Inspection.

Best regards, Alan Alewine

Elmore Project
Greer, SC

January 2003

Annual Well Inspections

Summary of Notes

Well #	Xducer Manuf.	Pump Amps	Pump Model	Notes
EW-01	KPSI	7.4	5E5	
EW-02	KPSI	8.8	10E5	Heavy red slime buildup on pump.
EW-03	KPSI	7.4	5E5	Repaired leaking pipe in vault.
EW-04	WIKA	9.0	10E5	
EW-05	KPSI	10.4	10E5	
EW-06	WIKA	11.0	10E5	New Extraction Well Pump installed in March 2002. Horsepower increased from 1/4 to 1/2. Heavy red slime buildup on pump.
EW-07	KPSI	7.3	5E5	Repaired broken suspension cable.
EW-08	KPSI	7.6	5E5	
EW-09	KPSI	11.6	5E5	New Extraction Well Pump installed in August 2002.
EW-10	KPSI	8.0	5E5	Repaired broken suspension cable & leaking pipe.

Elmore Project
Greer, SC

January 2003

Annual Well Inspections

Check Transducer Readings

		Depth to Transducer	Depth to Water		Calc. Hght of Wtr Col.	ProCont Xducer Reading	Difference
		a	b		=(a-b)		
EW-01		42.70	20.90		21.80	22.6	**-0.80**
EW-02		71.00	25.80		45.20	45.5	**-0.30**
EW-03		75.00	25.20		49.80	50.7	**-0.90**
EW-04		72.00	12.80		59.20	59.6	**-0.40**
EW-05		69.00	25.40		43.60	44.5	**-0.90**
EW-06		72.00	23.70		48.30	47.1	**1.20**
EW-07		34.50	12.70		21.80	20.8	**1.00**
EW-08		46.00	24.20		21.80	22.6	**-0.80**
EW-09		19.00	0.00		19.00	19.1	**-0.10**
EW-10		44.50	28.70		15.80	16.2	**-0.40**

Notes:
1. All measurements are in feet.
2. All readings are accurate within field measuring methods.
3. All transducers are reading accurate water level measurements.

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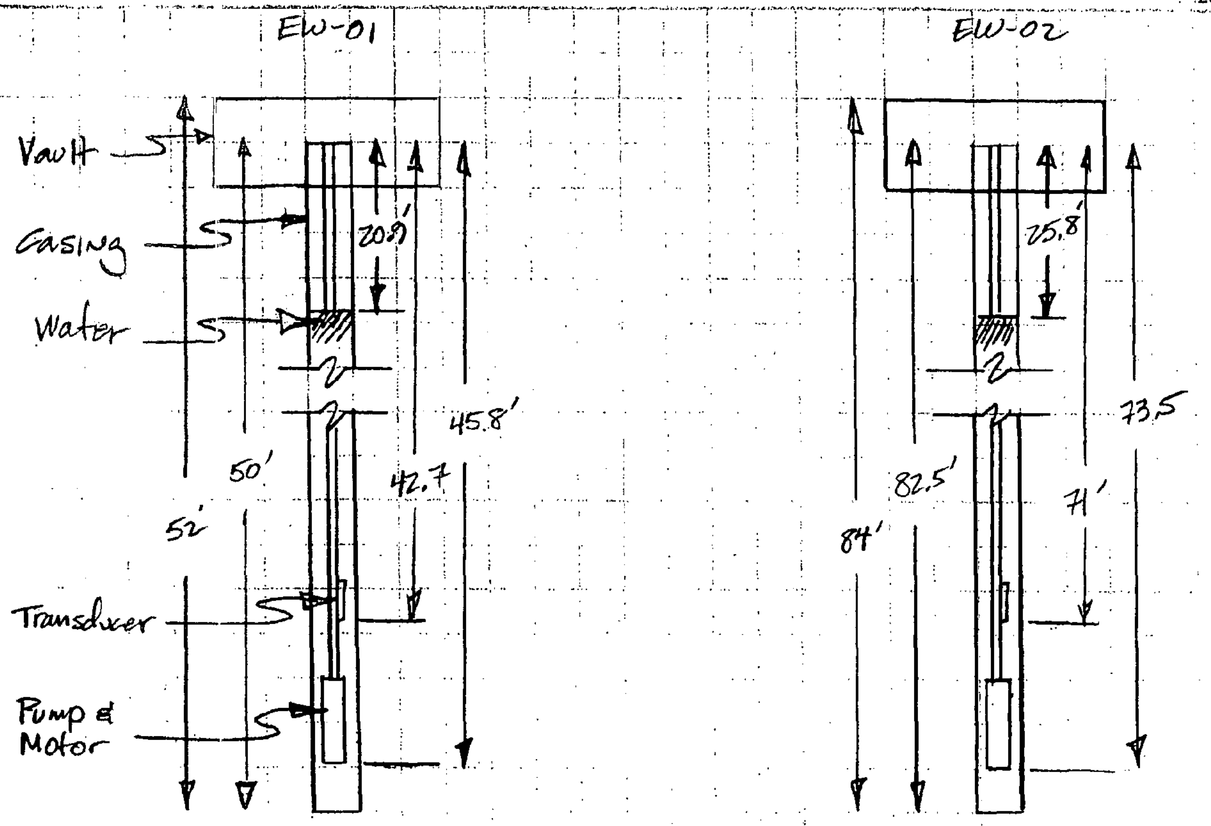
By AA Date 1-27-03 Subject Elmore Project - Annual Well Inspections Sheet No. 1 of
Chkd. By Date Proj. No.

.25 in. X .25 in.



Notes:

DTW = 20.9'
ProControl Xducer Level = 22.6'
Calc. Height of Water Col. = 21.8'
Diff = 0.8'

- Washed gray slime off pump.
- Cleaned pump intake.
- Cleaned flow meter & transducer.
- Pump, fittings, flowmeter, transducer in good condition.

- Transducer: KPSI brand

DTW = 25.8'
ProControl Xducer Level = 45.5'
Calc. Height of Water Col. = 45.2'
Diff = 0.3'

- Pump covered with heavy red slime. Scrubbed with Liquinox to clean pump & intake screen.
- Cleaned transducer.
- Pump operates with no problems. But red build up on pump may cause failure in future.

- Transducer: KPSI brand

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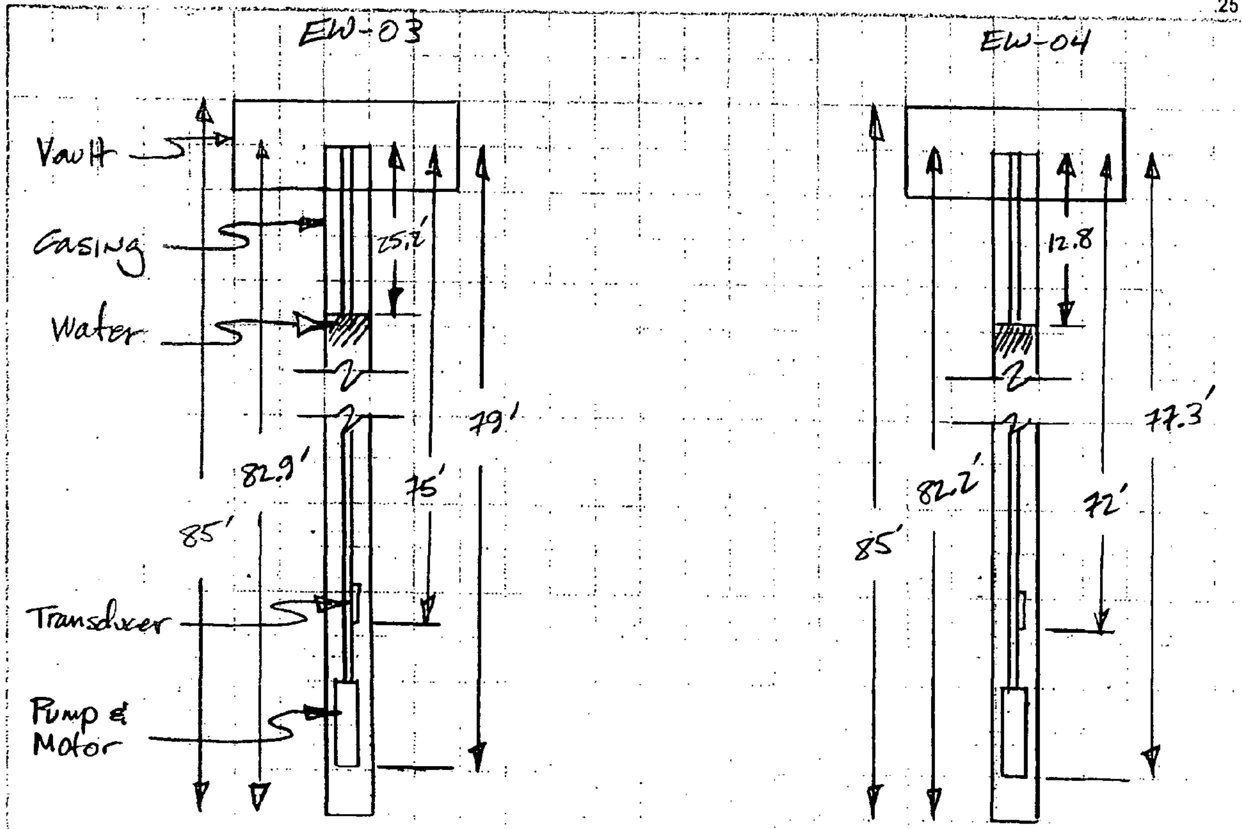
By M Date 1-27-03 Subject Elmore Project Sheet No. 2 of

Chkd. By Date Annual Well Inspections Proj. No.

.25 in. X .25 in.



Notes:

DTW = 25.2'
ProControl Xducer Level = 50.7'
Calc. Height of Water Col. = 49.8'
Diff = 0.9'

DTW = 12.8'
ProControl Xducer Level = 59.6'
Calc. Height of Water Col. = 59.2'
Diff = 0.4'

- Washed pump & intake screen.
- Cleaned flowmeter & transducer.
- Repaired leak inside vault at 1" threaded nipple. Replaced nipple.

- Washed pump & intake screen.
- No scum or corrosion.
- cleaned transducer

- Transducer: KPSI brand

- Transducer: WIKA brand (drying tube ½ spent)

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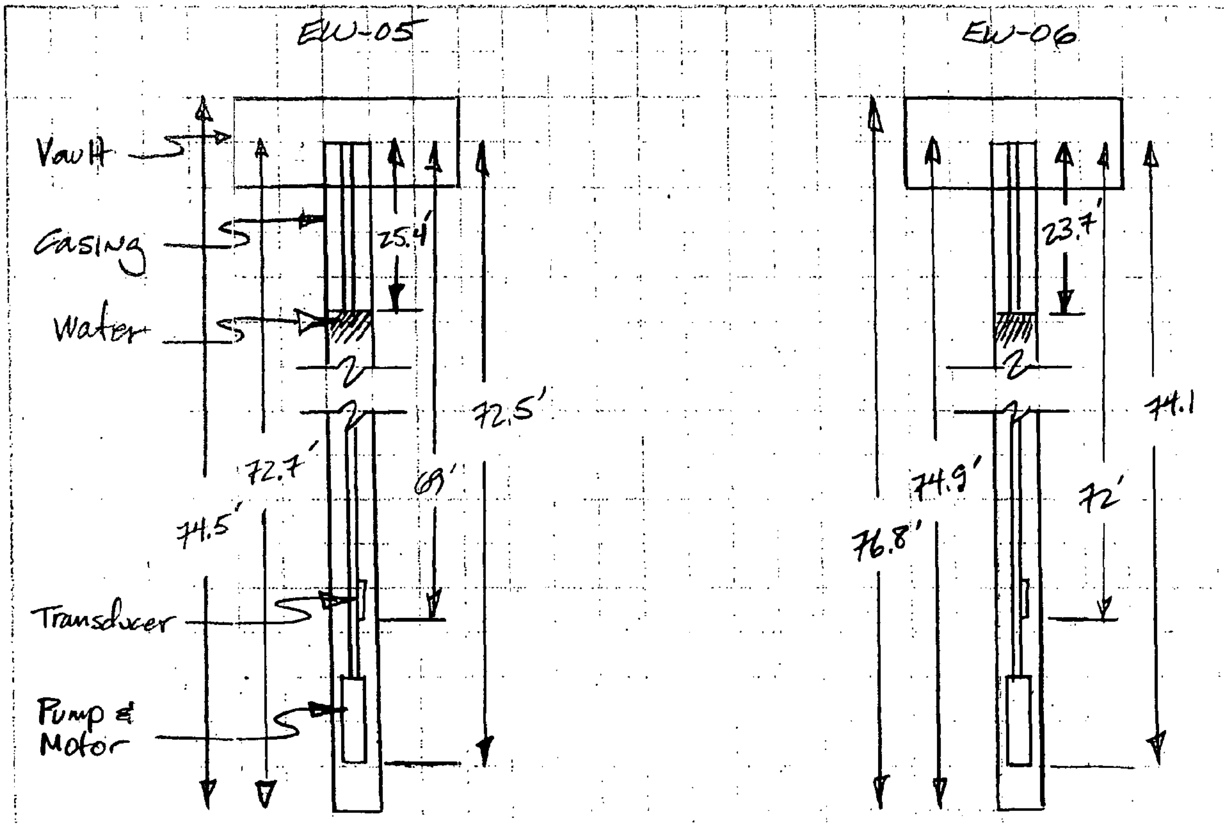
By: AH Date: 1-27-03 Subject: Elmore Project Sheet No. 3 of ____

Chkd. By: ____ Date: ____ - Annual Well Inspections Proj. No. ____

.25 in. X .25 in.



Notes:

DTW = 25.4'
ProControl Xducer Level = 44.5'
Calc. Height of Water Col. = 43.6'
Diff = 0.9'

DTW = 23.7'
ProControl Xducer Level = 47.1'
Calc. Height of Water Col. = 48.3'
Diff = 1.2'

- Washed pump & intake screen.
- Washed transducer.
- No slime or corrosion.

- Transducer: KPSI brand

- Pump covered with red slime. Scrubbed with Liquinox. Cleaned intake screen.
- Pump effluent nipple is covered with rust but still sound.
- washed transducer

- Transducer: WIKA brand (drying tube less than 1/4 spent)

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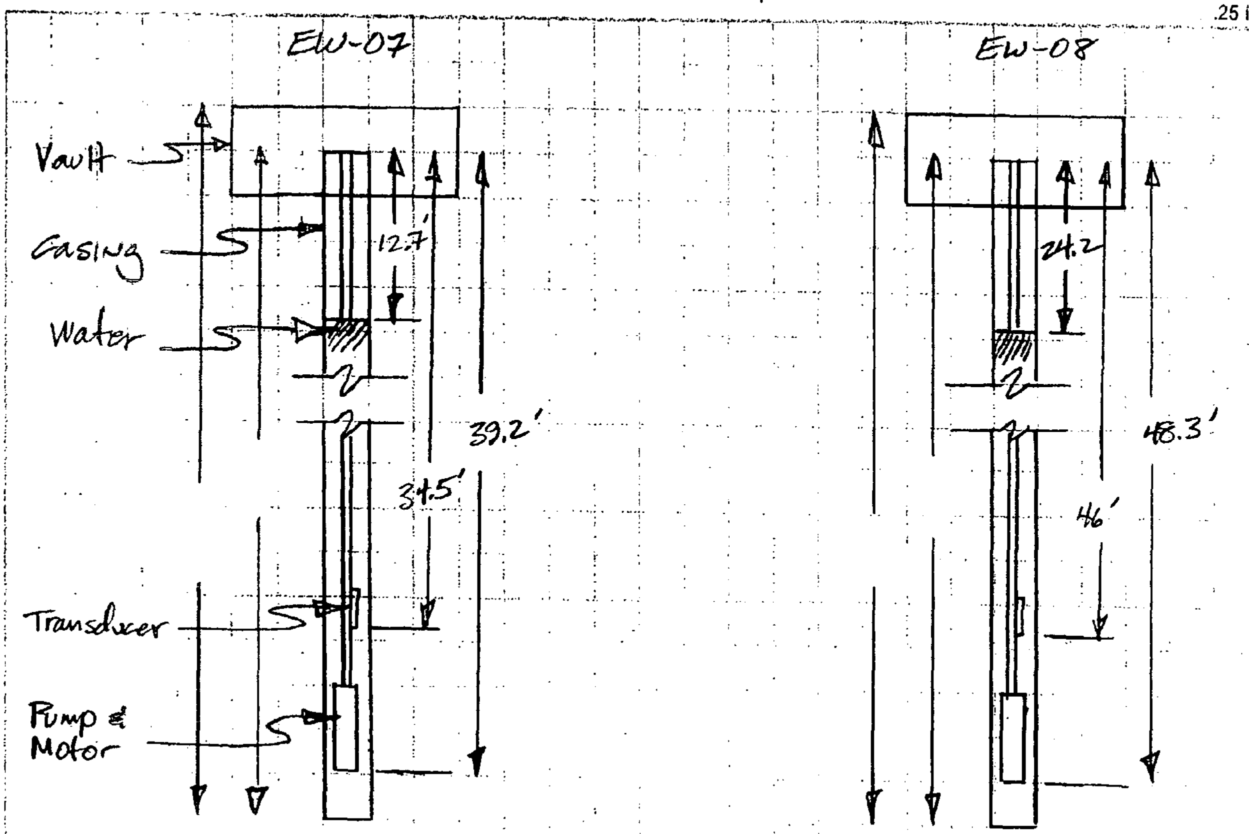
By AA Date 1-27-03 Subject Elmore Project Sheet No. 4 of

Chkd. By Date - Annual Well Inspections Proj. No.

.25 in. X .25 in.



Notes:

DTW = 12.7'
ProControl Xducer Level = 20.8'
Calc. Height of Water Col. = 21.8'
Diff = 1.0'

DTW = 24.2'
ProControl Xducer Level = 22.6'
Calc. Height of Water Col. = 21.8'
Diff = 0.8'

- Washed gray slime off Pump & Intake screen.
- Cleaned Flowmeter & transducer.
- Suspension cable broken at pump attachment. Repaired and re-attached.

- Pump & Intake screen very clean.
- No scum or rusty buildup on parts.
- Washed Flowmeter and transducer.

- Transducer: KPSI brand

Transducer: KPSI brand.

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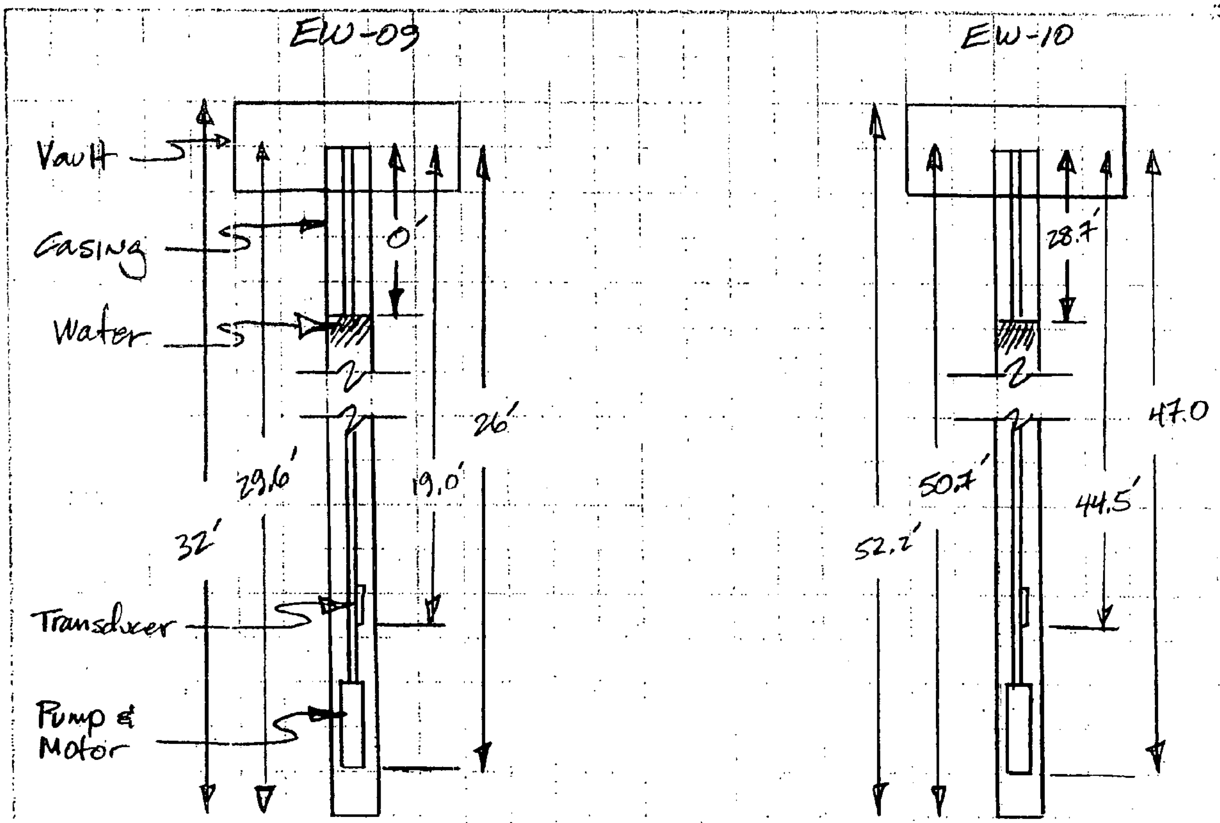
By AA Date 1-27-03 Subject Elmore Project Sheet No. 5 of
Chkd. By Date - Annual Well Inspections Proj. No.
.25 in. X .25 in.



Notes:

DTW = 0' (at top of casing)
ProControl Xducer Level = 19.1'
Calc. Height of Water Col. = 19.0'
Diff = 0.1'

- This well was converted from a shallow sump to a 30' well in June 2002.
- Washed pump. Cleaned slime off pump intake.
- Cleaned flowmeter and transducer. Flowmeter had heavy crusty buildup. Cleaned.
- With pump off, well water was overflowing casing.
- Faulty flowmeter was identified today & disconnected. (Pump is off)
- Transducer: KPSI brand

DTW = 28.7'
ProControl Xducer Level = 16.2'
Calc. Height of Water Col. = 15.8'
Diff = 0.4'

- Pump and intake screen very clean.
- Reducer and nipple at pump effluent is corroded/rusty. Replacement not needed yet
- No odor noticed. (Strong odor noted previously)
- Fitting inside vault had slow drip. It was repaired.
- Flowmeter and transducer very clean
- Suspension cable broken at pump attachment. Repaired and reattached.
- Transducer: KPSI brand.